RAILROAD GAZETTE

FRIDAY, JUNE 19, 1903.

CONTENTS

Contributions

Flattening of Driving-Wheel Tires.

TO THE EDITOR OF THE RAILROAD GAZETTE:

A curious case of driving-wheel tires flattening exists on one of the railroads in the Northwest, and in the hope of bringing out discussion on the same, I would be glad if you would publish the difficulties experienced and ask suggestions for relieving the trouble, which, so far, the road has not been able to eliminate.

The three engines on which this trouble has developed were received from the builders with their valves set line-and-line in full gear, and are line-and-line on the exhaust side and have 7/8 in. outside lap. The engines are used in fast passenger service, hauling heavy trains over moderately heavy grades at a speed which sometimes reaches 60 to 65 miles per hour, but when first received they were unable to make the time. The valves were changed to 1/8 in. exhaust clearance, and 1/8 in. negative lead in full gear, which was found to be advantageous, and the exhaust clearance was increased to 3/16 in. and the negative lead in full gear to 3/16 in. The engines have given no further trouble in the matter of making time, but with the original setting it was found that the tires were flattened badly about 3 ft. ahead of the pin on the left side, and opposite the pin on the right side. This flattening was greater on the left main driver than on the right, the main drivers being the only ones flattened.

The engines are a 4-6-0 type with 20-in. cylinders, piston valves and 73-in. driving wheels, right side leading. On first indicating the engine it was found that the compression ran very high, but this was eliminated to a large extent by the changes in the valve settings; but it did not seem to affect the flattening of the tires in the least. The engine was therefore brought into the shops and the counterbalancing carefully gone over, and rebalanced in accordance with the Master Mechanics' rules. It was turned out again and has done excellent service, but the flattening still continues at the rate of about 1/16 in. in 30 days, and at a ratio of about 3 to 1 between the left and right main tires. It is understood, of course, that a part of this flattening may be accounted for by the manner in which enginemen start these heavy trains out of stations, but the writer is at a loss to know why the left side should be so much heavier than the right side.

X.

The Injunction Against the Buckeye Jack Mfg. Co.

Canton, Ohio, June 9, 1903.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your most excellent paper of May 22 there appears under the title "Barrett Jacks" a statement made by the Duff Manufacturing Company, which would be calculated to mislead the public. In the suit referred to, the matter at issue was not the manufacture or the selling of jacks; the only point involved was the distribution of a certain catalogue issued by the Buckeye Jack Mfg. Co. At the time of the hearing before Judge Lacombe the attorney for the Buckeye Company did not resist the granting of the injunction after it was determined that the injunction only went to the restraining of the catalogue complained of, and did not in any way interfere, hinder or retard the manufacture and sale of the jack known to the trade as the "Buckeye jack." The honorable judge could not do other than he did owing to the fact that our attorney consented to the injunction, and there was no legal controversy whatsoever.

The Buckeye Jack Manufacturing Company is not enjoined from the manufacture and selling of its most excellent jacks; on the other hand it was distinctly understood that it had a perfect right to manufacture and sell the jacks. We deem it of importance that this statement be inserted in your most excellent paper for the purpose of preventing the trade from being misled as to the injunction reaching to the manufacture and selling of jacks.

THE BUCKEYE JACK MFG. CO.

By C. J. Folla, Sec. and Treas.

[We also deem it of importance to remind readers of the *Railroad Gazette* that the conduct of the Buckeye Jack Manufacturing Company was such as to make it necessary for a Judge of the United States court to enjoin it "from making any statements or representations which might be calculated to mislead the trade or the public," etc. This is a somewhat novel instance of enforcing by injunction a reasonable observance of the eighth and ninth commandments as recorded by Moses. EDITOR.]

More About Wheel Arrangements.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Mr. Paul Warner's defence of the ten-wheel engine, in the *Railroad Gazette* May 22, looks very plausible on the face, but looking into it thoroughly I still think that the four-wheel truck is unnecessary. Mr. Warner says the wheel loads on this engine were limited and to get the required boiler power 10 wheels were necessary to carry the weight. I note in the detailed description of this engine that the driving journals are 8½ in. x 11 in. With 20,000 lbs. on one journal, the pressure per sq. in. is but 213 lbs., which is quite moderate. Now substitute a journal 9½ in. x 12 in., and put 140,000 lbs. on the drivers, and the load is 23,333 lbs. on one journal, or a pressure of 204 lbs. per sq. in. There may have been conditions prohibiting a 9½ in. or even a 9 in. x 12 in. journal, but that is not the fault of the engine. I wanted to imply that in this particular case a 2-6-2 arrangement would be an improvement or make a better engine. Any movement of the trailing truck springs would tend to put more weight on the drivers where it would be useful on a dirty or greasy rail. I wanted to make it clear that a four-wheel steering gear was unnecessary.

I have before me a description of a 4-4-2 engine of the same company (C. R. R. of N. J.). This engine has 99,400 lbs. on four wheels, or 260 lbs. per sq. in. on the journals. A total weight of 191,000 lbs. on 10 wheels, as against 161,000 lbs. on 10 wheels with the other engine. The 4-4-2 engine has a tractive power of 22,950 lbs., and a consequent adhesion of 4.3 or .5 less than the 10-wheel engine, yet I believe that the 4-6-0 engine will be the more "slippery" of the two. The writer does not wish to be understood as a total unbeliever in theory, but has found that some of these theoretical adhesions were a delusion. They worked out well on a good rail, but the good rail is not a constant, and the engineman is expected to make as good time on the bad as on the good rail—which reminds me, there is a sand-box on the engine. In a recent issue of the *Railroad Gazette* is a picture and a brief description of a new engine hauling *heavy fast passenger trains* on the Lehigh Valley. Think of a fast passenger engine, steered by a pony truck, and murdering the roadbed. Yet the account says, "It is said these engines are giving satisfaction." It is certainly a very businesslike appearing engine, with a tractive power of 27,960 lbs., but the particulars of weights are not at hand, so the adhesive factor cannot be computed, but with the large wheel diameters this should be high. This engine should be a stayer. Compare this with a late engine of the C. & O., which has the 4-6-2 wheel arrangement designed (as the account says) "to fit the conditions of the service existing on that line." The six drivers carry 131,000 lbs. and the tractive effort is 31,997 lbs., with an adhesive ratio of 4.1. A few months later a 4-4-2 of the same company is described, probably designed also to "fit the conditions, etc." Isn't it strange how quickly conditions change? On four drivers, 93,000 lbs. and 80,000 lbs. on truck and trailers, traction 27,072 lbs., adhesion 3.0. Who says *she* will not be a "dancer"?

Mr. Warner says 4.5 is by no means too high a ratio for a freight engine. The writer agrees with him, and neither would 5 be too high for a bad rail. For passenger work 4.0 may be admissible, but if heavier engines are to be built let us have the weight placed where it will be used in our business. Not long ago one of our "boys" complained of a certain 4-6-0 engine that would slip steadily all the way up a grade, not quite enough to "lose its feet" and dance, but just enough to use sand all the way up. Here is a case of useless wheels, yet the engineman is expected to make the time, or indulge in correspondence with the "Old Man," or his second, the "R. F. E." He is told there is nothing the matter with the engine and can think what he likes. Of what use would the traction increaser (lever connected) be in this case? Drop the lever down to utilize it, and what would be the result? More sand—and trains haul hard on sand.

While on the subject of traction, adhesion, etc., it might not be out of order to consider a recent article on "The Utility of the Dynamometer Car," *Railroad Gazette* May 29. The article says in part that the laboratory took out different classes of engines and figured out how much those engines ought to pull up the grades. That part of the proceeding is all right, but it is not stated what conditions were taken as the basis of the calculations. We take it for granted that the tractive effort is calculated by the usual formula, and the engine must haul its equivalent; but were the figures made for one, and the best condition only? Except possibly the usual allowance for cold weather? Or was there any margin allowed for different rail conditions? I have seen engines fitted with chilled tires. These engines would figure all right, both for traction and adhesion, but they could not utilize either. Tires vary in composition, and the theoretical power of the engine is not available. It is very well to say the laboratory figured it out (and "figures won't lie"), but the figures do not always match the results.

Another part of the article says, "If the engine does not pull *her* tonnage, we can go to the mechanical department and say, What is the matter with your engine? She is not doing her best." (Poor thing, like others of her sex, her work is never done). *She* is probably a pool engine, and being such is run by Tom, Dick and Harry, each of whom tries to get all he can out of her, with the least possible expenditure of time or trouble on his part. Each one says in turn "*She* ain't my engine." Again, *she* ought to have gone into the shop long ago, but the demand for power is so great that *she* cannot be spared, and in this condition, similar to a worn out old horse, is expected to do as much as the engine just turned out of the shop. The mechanical department is between two fires. On one side it is, "What is the matter with your engine," on the other it is, "You must keep down the cost per engine turned out of the engine house," and "Your shop expense is too high for engine put through." Oh! yes, the dynamometer car is a great thing. The writer will agree with Mr. Rhodes that there are soldiers among enginemen as well as in other trades, but there is a remedy. As to the engines being more damaged out of service than hauling tonnage, who is to blame for this? Engines must be washed out, and the transportation department is asking for power. As a result the engine is put through the "process," fire dumped, steam blown off, water let out at a high temperature, the washing done with a much cooler water, boiler filled, fire started and forced. If there is time while this is being done to do any of the work reported, grind gage cocks, pack injectors and valves, this is done, if not, let her go.

J. V. N. CHENEY.

Local Freight Agents' Association.

The sixteenth annual meeting of the American Association of Local Freight Agents' Associations was held at Savannah, Ga., on June 9. The meeting was called to order by President Wm. H. Bumpas (Agent of the Louisville & Nashville at Nashville) at 12 o'clock Tuesday. Thirty-six local Associations were represented by 86 delegates. Many delegates who had expected to attend were prevented by the floods and some arrived on Tuesday evening and Wednesday morning.

At the opening meeting the delegates were welcomed by Mayor Meyers, Capt. D. G. Purse, L. E. Chalmor and Hon. Walter G. Charlton; and the responses were by J. V. Braden, E. E. Zeigler, J. H. Garner, and C. H. Newton. Captain Purse told of the development of transportation in Savannah in the building of the Central of Georgia Railroad and the despatching of the first steam vessel to cross the Atlantic ocean, the steamer "Savannah."

In the responses it was stated that the 664 members of the Association with the aid of about 75,000 assistants, handled approximately 150,000 tons of less than carload merchandise every 24 hours, and in same time received and forwarded as many as 200,000 full carloads.

The following local Associations, organized during the last year, were admitted to the American Association: Grand Rapids, Mich., seven members; Birmingham, Ala., six members; Mobile, Ala., five members; New Orleans, La., nine members, and Jacksonville, Fla., seven members, making a total enrollment of the American Association of 70 local Associations, with an individual membership of 690 agents. The Treasurer reported all bills paid and a balance in the treasury of $1,458.

The special committee on a new form of bill of lading

and shipping order blank reported progress. It had agreed upon and recommended a form to the Official Classification Committee. The committee was continued and instructed to try to get the Southern and Western Classification Committees to adopt a similar form.

The suggestion by Omaha that freight charges for the railroads represented by each association be collected through a clearing house, met with a division of sentiment, but by a small majority vote it was conceded that where practicable, the plan should be adopted; but not to increase the tendency to burden transportation companies with expense and annoyance of collecting charges that should be paid at the office of the delivering road at the time of delivery.

Wheeling, W. Va., topic, "Use of Way-Expense Bills for Billing" elicited a long discussion, which brought out the information that the Southern Railway had had such a system in use for three years; that the Baltimore & Ohio would begin its use on the first of July, as an experiment, and that Pennsylvania Lines West of Pittsburgh had decided to make the change. Only three members voted "No" upon a motion to recommend the general adoption of the system.

Chicago told the convention of a plan in use by some of the lines in that city of placing all station employees under probation for a time before payment of standard salaries, as an inducement to proficiency and for other obvious reasons. It was found similar plans were used by a few agents not closely restricted to methods by management, and the idea was unanimously approved.

New York came forward with a proposition to establish a clearing house for over and short reports between all lines at large terminals. The Cincinnati plan of each agent rendering a statement of overs and shorts weekly to the Secretary of the Association, who prepares and gives to each member a copy of a statement showing all the discrepancies existing, at the time, within the jurisdiction of the Association, was thought to be the best, and was to be recommended.

In response to an inquiry from Cleveland, Ohio, it was the voice of the Association that shipping orders made by shippers for shipments found to be incomplete may be changed by the railroad to agree with the articles received; but a change should not be made upon the receipt or bill of lading issued by the railroad without in all cases making a notation as to why the change was made.

Cincinnati reported having adopted the rule reported last year from Wheeling of storing all L. C. L. freight at expiration of 48 hours. It had proved advantageous to the railroads and shippers alike. The convention recommended that a similar rule be put in force at all the stations represented in this Association.

Other topics of interest were informally discussed with profit.

C. H. Newton, Agent of the Wabash Railway, at Toledo, was elected President for the coming year; B. L. Bugg, Southern & Central of Georgia R. R., Savannah, Ga., Vice-President; G. W. Dennison, Pennsylvania Lines, Toledo, Ohio, Secretary; J. H. Garner, Southern Railway, Atlanta, Ga., Treasurer. The time and place for holding the next annual meeting was referred to the Executive Committee.

The entertainments by the Savannah agents were much enjoyed. There was a smoker at the Tomochichi Club; comic opera at Thunderbolt Park; bathing and a fish supper at Tybee beach. The terminals were inspected on Wednesday afternoon. Trolley rides, visits to art galleries, Colonial buildings and other points of interest were much enjoyed by the ladies.

The attendance was much smaller than usual, for the reason mentioned, but no meeting has been more enthusiastic.

Foreign Railroad Notes.

In Germany much more than here refreshments are offered alongside the passenger trains by waiters attached to the station restaurants. The authorities in Saxony have recently ordered that these must include in their offerings cool drinking water for not more than 5 pfennige (1.2 cents) per glass of 0.4 litre (the ungodly may remember to have seen this measure of capacity on a small beer mug), or for 15 pfennige, glass included. Also they must offer selters or other mineral water for not more than 5 cents per small bottle. And they must offer fresh fruit in its season, with the price plainly marked. Both bottles and glasses must be kept perfectly clean, and the cold provision displayed at the station buffets must be kept under glass.

A German journal reports that the Russian-Chinese Bank contemplates building a railroad from Pekin directly northwest over the old caravan route across the great Mongolian desert to Kiachta, near the Russian border, and not far from Lake Baikal, where it would connect with the Siberian Railroad. As the advantage of this route it is pointed out that from Pekin to Lake Baikal it would be only about 1,500 miles, while by the Chinese Eastern and its connection with Pekin it will be about 2,300. The man without a map before him will bear in mind that the present lines require you to go several hundred miles from Pekin northeast to reach the Chinese Eastern, which extends thence northwestward. But the caravan route is for the most part across a desert, and a railroad over it would have to live on the through traffic, which has been enough to support a good many camels and their drivers, but would doubtless starve a railroad. On the other hand, the Chinese Eastern is for the most part across a productive and well peopled country; and the Russian government is not likely to look with favor on a competitor for its through traffic until at least it has begun to make some return on the vast sums expended on it.

The Russian iron industry is much older than this country; but only recently has it assumed considerable proportions, and its growth, highly protected, was rapid for some years; but was arrested in 1900, by a general depression of Russian industry, just as our iron industry has several times been checked in its growth. In 1887 the Russian pig-iron production was but 583,000 tons. Ten years later it was 1,850,400 tons, and reached its maximum of 2,882,800 tons in 1900. It was a little less the next year, and in 1902 was 2,784,600 tons. The furnaces are not producing nearly to their full capacity, and the business is considered now very unsatisfactory. For a country of more than a hundred million people, this is an insignificant production, but for the moment it seems in excess of the demand.

The Goss Series Distilling Apparatus.

BY CHARLES DUCAS, M.E.*

The experience of years in the alkali regions and other places where the use of impure water is costly has proved the economy of an evaporator if it is made sufficiently inexpensive. A variety of designs of evaporators are on the market, but the best economy that is claimed is 44 lbs. of pure water per pound of coal burned. It is the purpose of this article to describe an apparatus by which it is practicable to obtain between 70 and 80 lbs. of water per lb. of coal burned. An apparatus of this type has been built and successful tests have been made at Bagdad, California, on saline water containing over 400 grains of solid matter per gallon. The tests sustained the assumed thermodynamic action of the design and the actual capacity exceeded by 30 or 40 per cent. the calculated performance.

The apparatus consists essentially of a number of chambers, A_1, A_2, A_3, A_4, and B, arranged and connected as shown by the diagram Fig. 1. The working temperature and pressure of the several parts increases from A_4 to A_1. Heat is supplied the liquid in each chamber by vapor, or a mixture of vapor and liquid in the central

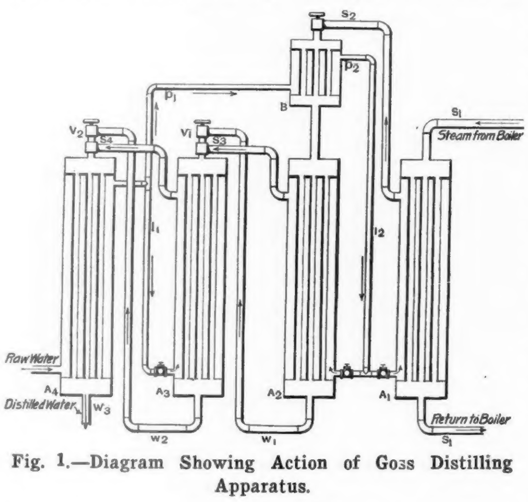


Fig. 1.—Diagram Showing Action of Goss Distilling Apparatus.

tubes, the initial source of heat being S_1, which conveys steam from a boiler to the upper ends of the tubes within the chamber A_1, and is returned to the boiler as liquid from the bottom of the chamber.

The water to be evaporated is delivered into the bottom of the chamber A_4 and is gradually heated by contact with the central tubes as it rises to the top. From this point it is conveyed by the pipe P_1 to the bottom of chamber B, a portion, however, being by-passed through the pipe l_1, to serve as a source of supply to the chamber A_3. The liquid is further heated in the chamber B, and finally passes out through the pipe p_2 at a temperature corresponding to that within the chamber A_2. The liquid is then fed to chambers A_2 and A_1 through the pipe l_2.

The return circulation of the vapor is as follows: The vapor given off in the chamber A_1 passes through the pipe S_2 and becomes a source of heat for the chambers B and A_2 through which it passes, being condensed by the time it reaches the bottom of chamber A_2. From this point it is conveyed to the valve V_1, where its pressure is reduced to the pressure of the vapor within the chamber A_2 and the mixture of water and steam thus formed further mingles with the steam delivered through the pipe S_3 from chamber A_2, the combined stream passing through the central tubes in A_3 and serving as its source of heat. Here again condensation takes place, and the water thus formed is conveyed by the pipe W_2 to the reducing valve V_2, where the pressure is reduced, and, passing on, mingles with the vapor given off from the chamber A_3. Finally, in chamber A_4 the combined stream thus formed is condensed, cooled and discharged as pure water.

It should be noted that the process is entirely continuous and progressive, and that it is quite possible to maintain a fixed difference of temperature between the various portions of the apparatus, the number of chambers employed being only limited by practical considerations.

There are no losses of heat which can occur from the apparatus excepting by radiation from the exposed surfaces, and excepting that represented by the difference in temperature between the outgoing and ingoing streams in chamber A_4. It will thus be seen that, by increasing the number of elements or "effects," it is possible to bring the temperature of the outgoing stream very near to that of the ingoing stream and hence this loss may be made to approach zero as a limit. Under these conditions, if radiation losses be neglected, the efficiency of the apparatus approaches 100 per cent. and the cycle becomes one of maximum efficiency. The whole operation does not violate any laws of thermodynamics. The process essentially secures the "transference of a condition." That is, the vapors formed in one chamber are made to give up their heat to the contents of another chamber, the combined effect passing on to a third chamber and so on, gradually becoming reduced in temperature, and finally being discharged as water.

The action of the apparatus, both in regard to efficiency and capacity, is readily made the subject of thermodynamic examination and analysis. Two factors govern the general design. They are: First.—The required capacity. Secondly.—The economy desired.

The first of these factors is a function of the difference in temperature between the initial source of heat, and the lowest temperature at which vaporization takes place in the system. That is to say, an apparatus that operates between the temperatures of 338 deg. and 212 deg. has approximately twice the capacity of a similar apparatus working between the limits of 338 deg. and 275 deg. The capacity is also a function of the rate at which heat is transmitted through the heating surfaces of the apparatus, which is purely a physical action, the numerical value of which is variously stated by different authorities. In all calculations hereinafter described, it has been assumed that each square foot of heating surface transmits 200 British thermal units per hour per degree difference in temperature. This value has been chosen rather conservatively from data published by a number of experimenters, and is lower than that employed by a number of firms manufacturing condensers, but, as before noted, actual tests show that this figure may be increased by 30 or 40 per cent. in practice.

The economy of the apparatus is a function of the number of elements employed. That is to say, the greater number of successive stages at which vaporization and condensation takes place, the higher will be the efficiency. Since, for any liquid, there is a definite relation between temperature and pressure, and since various practical conditions operate to fix limits, it will be convenient for the purposes of this description to recognize these different classes of apparatus.

Class A will include apparatus, all portions of which operate at pressures above that of the atmosphere; class B will include apparatus, all portions of which operate at pressures below that of the atmosphere; and class C will include apparatus, a portion of which operates at a pressure above the atmosphere and a portion at a pressure below the atmosphere. Practical and convenient ranges of pressure and temperature applying to each of these three classes, when designed for the distillation of water, are as follows:

Pressure and Temperature Ranges for the Several Classes of Apparatus.

Class.	Designation as to Pressure.	Absolute pressures. Highest.	Absolute pressures. Lowest.	Temperature F. Highest.	Temperature F. Lowest.
A........	High presusre	115	15	338	212
B........	Low pressure	15	1.0	212	102
C........	High and low pressure	115	1.0	338	102

The relations shown are merely chosen for purposes of illustration. So far as the working of the apparatus is concerned, any other practical limits might have been chosen. The relation of pressure to temperature would change if substances other than water were used. It is evident, also, that the source of heat to supply an apparatus of the low-pressure class may be the exhaust steam discharged from an engine.

Assuming for each class of apparatus, the ranges of pressure and temperature for water, which were employed as an illustration in a previous paragraph, and assuming, also, that there is no loss of heat by radiation, and no vapor losses from the delivered stream, the weight of water which will be distilled for each pound of saturated steam supplied from the source of heat, will be as follows:

Weight of Distilled Water per Pound of Steam Used.

No. of evaporator chambers.	Class of apparatus. A	B	C
3	2.8	2.6	2.6
4	3.3	3.4	3.7
5	4.6	4.3	4.1
6	4.9	5.1	5.6
7	6.5	6.0	5.8
8	6.6	6.9	7.5
9	7.4	7.7	8.4
10	8.2	8.6	9.3

An approximate relation applying to all classes of apparatus herein described, is represented by the formula, $W = 0.9\ N$, in which W is the number of pounds of water distilled for each pound of steam supplied, and N is the number of evaporator chambers. Results thus obtained, as well as those appearing in the preceding table, are subject to correction to cover losses due to the pres-

*Associate Editor of the *Railroad Gazette.*

ence of vapor in the discharged stream, the extent of which will be hereafter defined.

As previously explained in connection with the description of the action of the machine, all condensation is the result of the cooling action of the incoming stream of liquid feed. Under certain conditions, this will be insufficient, in which case a portion of the issuing stream delivered from the apparatus will be vapor and hence will be loss. The extent of this loss, if any, decreases as the number of chambers is increased. In apparatus of the class A, it entirely disappears when seven evaporator chambers are used, but in types B and C there will be a slight loss even when as many as 10 evaporator chambers are used. The percentage of the total weight of the discharged stream which will be in the form of vapor is as follows:

Percentage of Discharged Stream Lost by Vaporization.

No. of evaporator chambers.	Class of apparatus. A	B	C
3	21	33	32
4	11	25	22
5	6	19	16
6	2	16	12
7	0	13	10
8	0	11	8
9	0	9	7
10	0	8	6

The number of square feet of heat-transmitting surface required in each element (one evaporating chamber and its attached heater) on the basis of assumptions already defined, to distill 1,000 gal. of water per hour from a temperature of 60 deg. F. is as follows:

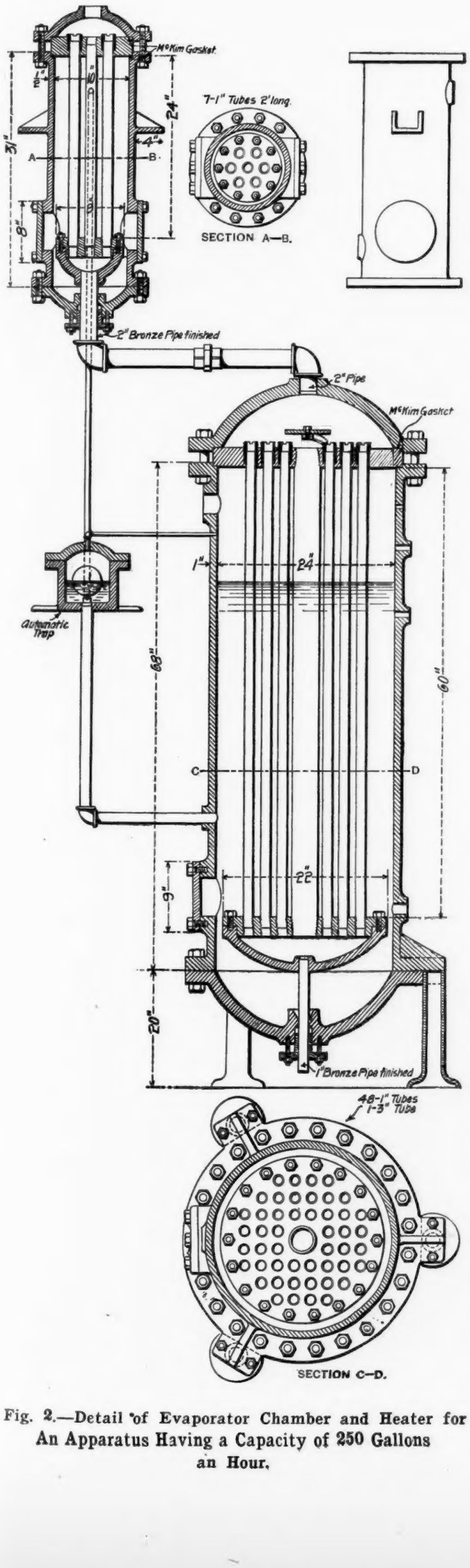


Fig. 2.—Detail of Evaporator Chamber and Heater for An Apparatus Having a Capacity of 250 Gallons an Hour.

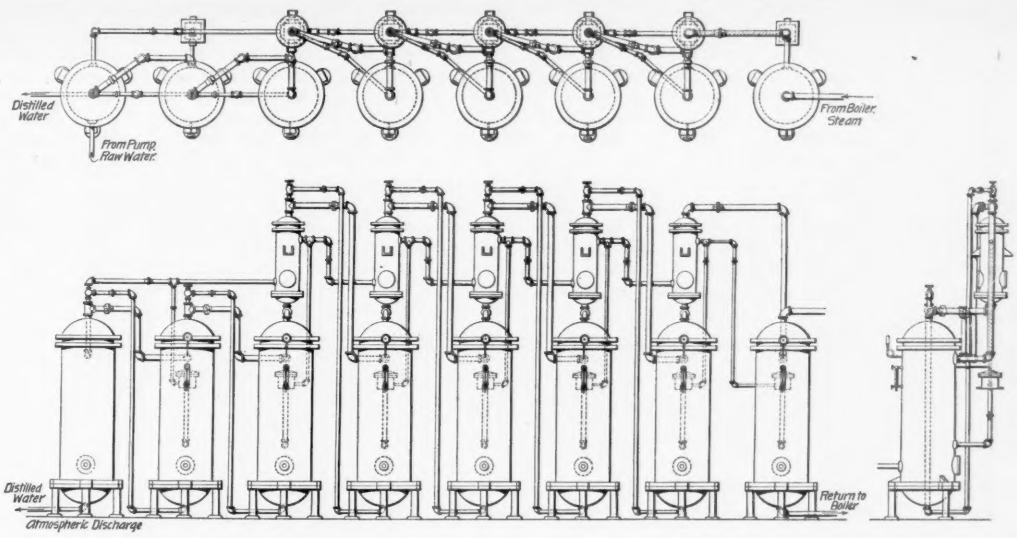


Fig. 3.—Erection Diagram of Goss Distilling Apparatus Having a Capacity of 250 Gallons an Hour.

Square Feet of Heating Surface in Each Element per 1,000 Gallons of Water to be Distilled.

No. of evaporator chambers.	Class of apparatus. A	B	C
3	343	373	222
4	344	374	223
5	345	375	224
6	348	376	225
7	347	377	226
8	348	378	227
9	849	380	228
10	350	381	330

The total amount of transmitting surface required for any apparatus will be found by multiplying the number of evaporator chambers it is to contain by the proper value from the preceding table. For example, if it is required to design a seven chamber apparatus of the A class to distill 1,000 gal. of water per hour, then the total number of square feet of heating surface for the whole system will be seven times 347 sq. ft. plus the heating surface of the first heater, which is usually made the same size as one of the evaporator chambers. In a similar manner, the heating surface required by the other systems and for any number of chambers may be determined.

The size of the feed-water heaters varies with the quantity of water which each must handle. Calling the chamber of highest temperature 1, and that of the next lower temperature 2, etc., the following is the percentage of the total feed which must be handled by the several heaters of any given system:

Percentage of Total Water Passing Each Heater.

No. of evap'r chambers employed.	Designation of Heater. 1st	2d	3d	4th	5th	6th	7th	8th	9th	10th
1	100									
2		100								
3		71	100							
4		53	76	100						
5		44	63	81	100					
6		37	54	70	84	100				
7		33	48	62	75	87	100			
8		27	40	52	64	75	86	100		
9		25	37	48	58	68	78	88	100	
10		23	33	43	53	63	72	81	90	100

For example, assume a seven chamber evaporator delivering 1,000 gal. of water per hour. In the horizontal column corresponding to the seven chamber system will be found a series of numbers beginning 33, 48, 62, 75, 87 and 100. These numbers represent the percentage of the total water which each successive heater must handle, passing down the scale of temperatures. Thus, the heater above the second chamber must handle .33 times 1,000 gal. The heater above the third chamber handles .48 times 1,000 gal, etc. The last heater (that of lowest temperature, A, Fig. 1) handles all the water. Knowing now the amount of water to be heated in each chamber, and, also, the various temperatures, the proper design of the heater becomes a simple matter.

With these general facts at hand, it is not difficult to proceed with the details of a specific design. Thus, assume that it is required to design a class A apparatus to be supplied with steam at 115 lbs. absolute pressure which will distill 250 gal. of water per hour. By reference to data already presented, it will be seen that for the "A" type, the loss by vaporization in the discharged stream becomes zero when seven chambers are employed. If a greater number than seven chambers is employed, the discharged stream of water is cooled below 212 deg. For the present purpose, we will select a seven chamber apparatus. The temperature of the source of heat corresponding to 115 lbs. absolute pressure is 338 deg. The temperature of the coolest chamber as determined by the choice of this class is 212 deg. Hence, the range of temperature is 338 minus 212, or 126 deg. The difference in temperature between each successive element is one-seventh of the total difference, or 18 deg. The pressure and temperature in each chamber will be as follows:

Chamber.	Temperature.	Pressure.
1	320	75
2	302	54
3	284	38
4	266	24
5	248	14
6	230	6
7	212	0

All relations between pressure and temperature are obtained from tables of the properties of saturated steam.

It has already been shown that a seven-chamber evaporator working under the conditions of pressure stated, which will distill 1,000 gal. of water per hour, must have 347 sq. ft. of heating surface in each element. Consequently, an apparatus to deliver 250 gal. per hour, will require for each element one-fourth of 347, or approximately 87 sq. ft. Of this 87 sq. ft., a portion goes to make up the feed water heater, the evaporator chamber containing the remainder.

The amount of water which must be handled by each successive heater, on the basis already defined, is:

Designation of heater.	Percentage of total.	Gallons.	Pounds.
2d	33	82	693
3d	48	120	1008
4th	62	155	1302
5th	75	187	1575
6th	87	217	1827

From the known weight of water to be handled by each heater per hour, the sq. ft. of heating surface required by each small heater is calculated by the following formula:

$$A = \frac{W}{U} \times \log_e \times \frac{T_s - T_o}{T_s - T_d}$$

in which, A = sq. ft. of heating surface required.
W = number of lbs. of water per hour.
U = B. T. U's. absorbed by the water per sq. ft. of surface per degree difference of temperature per hour (assumed to be 200).
T_s = temperature of steam on inside of tubes.
T_o = temperature of water entering heater.
T_d = temperature of water leaving heater.

Inasmuch as each heater receives its supply of heat from the chamber next higher in the series and the water to be heated has a temperature corresponding to that of the chamber next lower in the series, it follows that the value of $T_s - T_o$ will always be double the value of $T_s - T_d$. The preceding formula will, therefore, reduce to:

$$A = \frac{W}{U} \times \log_e 2 \text{ or, } A = .00346 \times W.$$

By substituting the values of W set forth in the preceding table, the following values for the amount of heating surface required by each heater are obtained:

Designation of heater.	Sq. ft. of heating surface.
2d	2.4
3d	3.4
4th	4.4
5th	5.3
6th	6.2

Since all heaters are relatively small, it will serve for all practical purposes if all are made the same size and if made equal to the mean value obtained as above, the surface of each will be 4.3 sq. ft.

This provides for all small heaters. The last heater A (Fig. 1) is always assumed to have the same amount of surface as the evaporator chambers.

These calculations finish the design so far as thermodynamic relations are concerned. The working out of the various mechanical details is well shown by Figs. 2 and 3. Each evaporator chamber contains 49 tubes having a heating surface of 88 sq. ft., and each small heater contains seven tubes having a heating surface of 4.8 sq. ft. These values closely check the calculated dimensions. Each small heater is set above and back of the larger chamber and the water level in the evaporator chambers is maintained by means of a float trap. In all other respects the circulation of the steam and water is

the same as previously described in connection with the diagram, Fig. 1. The tubes are nested in such a manner that they can be readily removed for cleaning.

In a low-pressure system, or in a high-and-low pressure system (classes B and C), some modification in the mechanical arrangement shown by the diagrams is necessary. Thus, the chambers which are low in the scale of pressures must be so arranged that the water of condensation from one chamber will flow freely to the chamber next lower in pressure. That is to say, it will be necessary to place one element above the other. The reason for such an arrangement is that the pressure difference between each chamber is not sufficient to overcome the head of water equivalent to the distance from the bottom of one chamber to the top of the next. Just how many chambers will need to be so arranged can only be stated when the conditions of the individual case shall have been defined. Obviously, the cycle will not be interfered with or the working of the apparatus changed if all the elements are arranged in a vertical series instead of a horizontal series.

The apparatus is controlled by the United States Distillation company, Indianapolis, Ind.

The Great Northern Shops at St. Paul.

(WITH AN INSET.)

In locating and retaining the principal shops of the Great Northern at St. Paul, Minn., proximity to the main sources of supply dominated all other considerations, such as location near to the traffic center, convenience to the several parts of the line and branches, etc. What are known as the Jackson street shops in St. Paul, were built in 1880, comprising both locomotive and car departments. With the exception of some small additions these shops have remained practically the same as when built, the erecting shop having 13 pits, 12 of which are available for repairs.

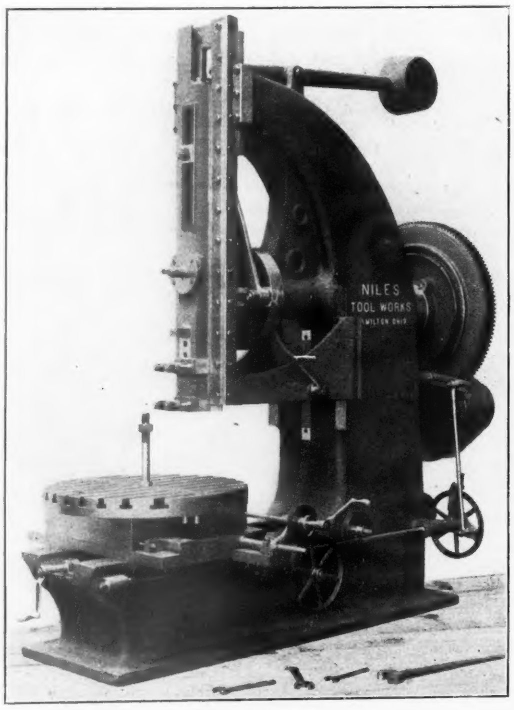
When the need came for a new and larger locomotive department there was no room for expansion upon the old track, which is surrounded by the city, and a new site at Dale street about 1.1 miles west of Jackson street was selected.

The erecting shop is the cross-pit type, the machine and erecting departments being in one building. Opposite to them, and under one roof, are the boiler, blacksmith and tank shops, with a transfer table between. The power station is so placed that when the new car shops are built it will have a central location. The storehouse is served by a track on each side, while a second track on the south side is available if needed. The transfer table is accessible by four separate tracks, not including the south storehouse track. In addition, it may be reached by a track running through the blacksmith shop, or any of the tracks through the tank shop.

Air and steam heating pipes and electric power and lighting feeders are carried in a 7 ft. x 7 ft. concrete tunnel, which runs from the west side of the power house across to, and inside of, the north wall of the blacksmith shop as far as the center of the building; it then turns at right angles and runs the length of the blacksmith and boiler shops. A lateral passes under the transfer table pit to the machine and erecting shop and connects with a longitudinal tunnel running the length of the building. Also a branch 5 ft. x 6 ft. starts at the northeast corner of the blacksmith shop and runs over to the storehouse, and another runs from the locomotive shop to the laboratory.

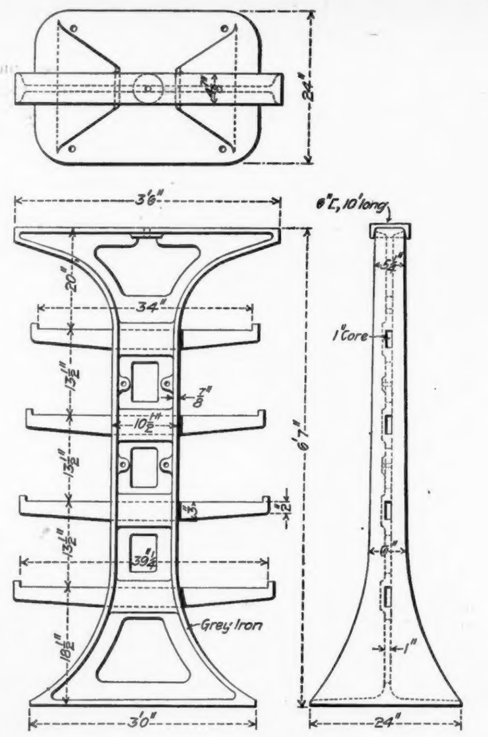
The Great Northern at present has 643 engines, and with contemplated additions this will be increased to 718. There are other large shops on the road, so that the number of engines directly dependent on St. Paul shops is about 300. But it is also expected that some of the very heavy repairs from other shops will be brought here, also the overflow from these other shops, so that a capacity of from 30 to 35 engines a month has been provided. These shops also prepare a large amount of stock material for the system.

The relative sizes of departments of these shops as given by Mr. Walter A. Berg (*Railroad Gazette*, April 3, 1903), taking the erecting shop as 100 per cent., is 100 per cent. for the machine shop, 136 per cent. for the boiler shop and 84.3 per cent. for the blacksmith shop. The relations recommended by Mr. Berg are 140 per cent. for machine shop, 90 per cent. for boiler shop, and 70 per cent. for blacksmith shop.



Niles Slotting Machine—Great Northern Shops.

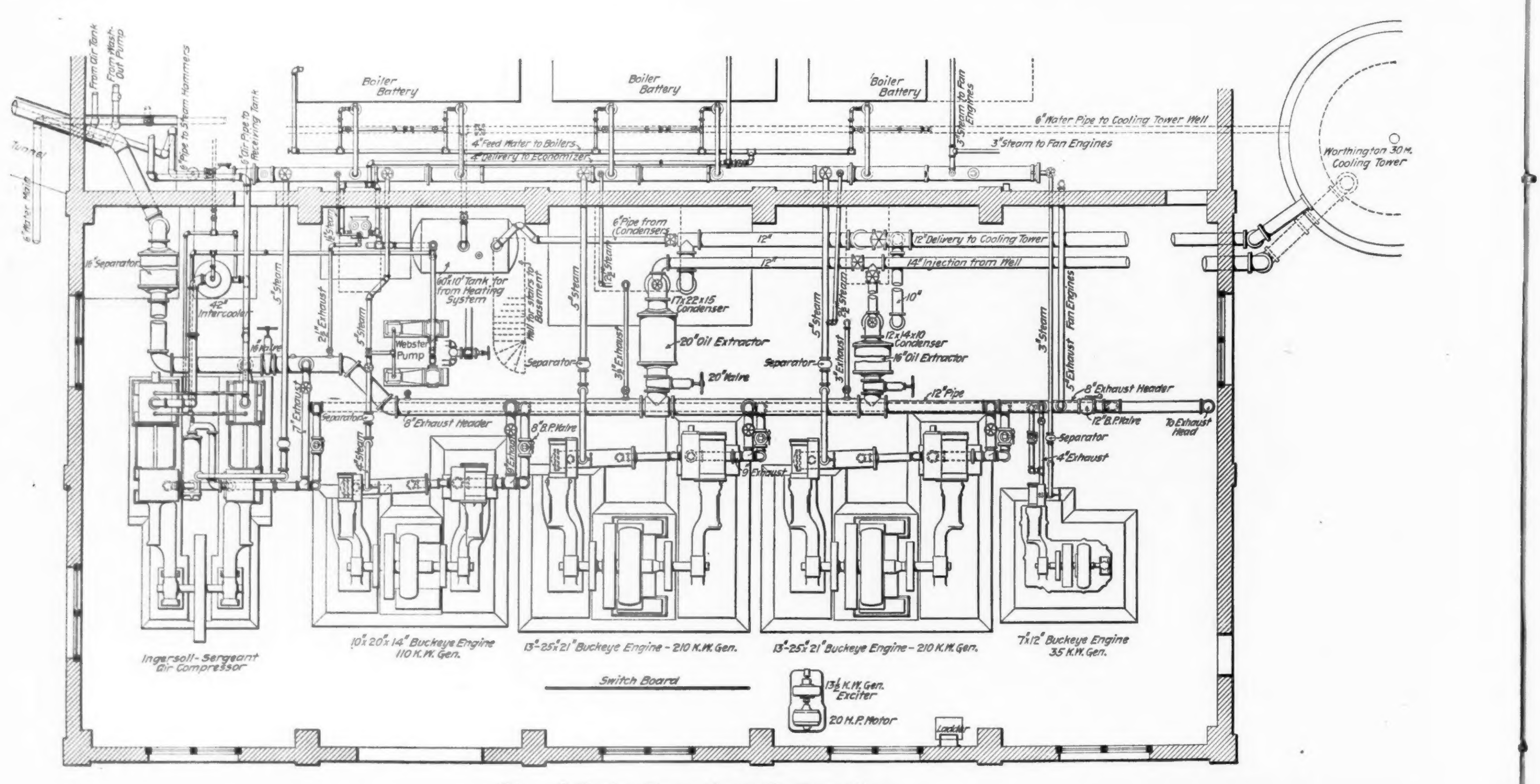
The machine and erecting shop is a two-bay building, 150 ft. x 600 ft., divided equally by a center row of columns into machine and erecting departments. The foundations are rubble masonry, 6 ft. 8 in. deep, on a base course of concrete, 2 ft. 6 in. deep, resting on timber piling. The walls are brick, 16 in. thick. The roof trusses are wood, spaced 24 ft. centers, two being used to span the width of the building. The center columns on which they rest are 14 in. x 14 in. timber posts, and at the sides they are supported by the brick walls. Midway of the machinery side there is an additional row of columns to stiffen the trusses for shafting support, and also to furnish support for shafting. At the center of the roof and extending the length of the building is a monitor 32 ft. 4 in. wide with glazed sides, and skylights in the roof. Also in the roof of the building over each bay is a double row of skylights, two between each two trusses. All skylights have ¼-in. ribbed glass, below which is double-strength window glass. Suitable drainage is provided for the moisture which collects on the upper surface of the latter. Stretched under all skylights is wire netting to prevent broken glass from falling into the shops.



Material Rack Between Erecting Pits—Great Northern Shops.

The roof, which is gravel, has double sheathing separated by 1 in. x 3 in. strips to provide an air space and prevent sweating. Monarch roofing is laid over the sheathing. The flooring is 3 in. x 12 in. plank on 6 in. x 8 in. sleepers bedded in 18 in. dry sand filling.

The boiler, blacksmith and tank shop building, which is 235 ft. x 425 ft. 2 in., is in three bays, those on each side being 90 ft. wide, and the middle one 72 ft. wide. This building is quite similar in construction to the locomotive shop, except that the monitor is wider, spanning the whole of the middle bay, and it has but one row of skylights over the west bay. At the south end of the boiler shop, in the middle bay, is a riveting tower, the height to the top of rail for crane runway of which is 54 ft. 6½ in. The crane runway next to the partition wall is carried on timber trestles, the uprights for which are 12 in. x 12 in. The other runway is carried by a reinforced roof truss.



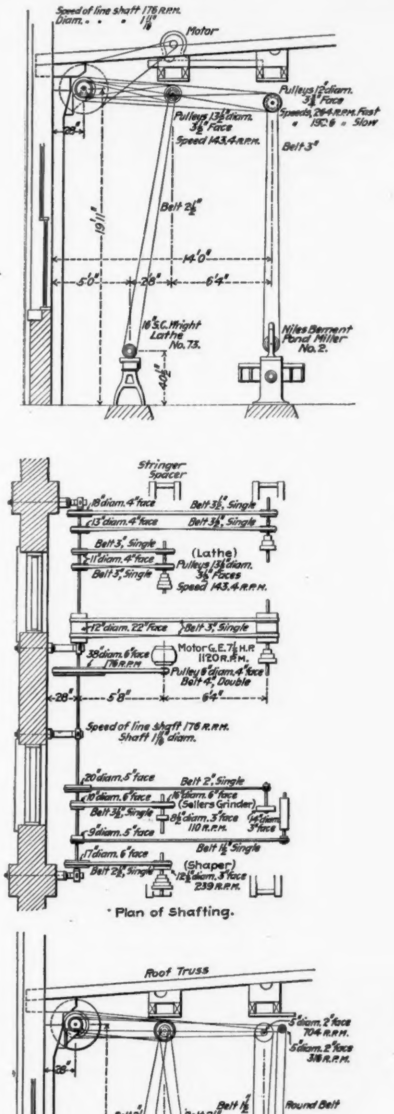
Plan of Engine Room—Great Northern Shops.

Power House.—This building is 106 ft. x 110 ft. 2 in., divided by a 16-in. brick partition wall into boiler room, 52 ft. wide inside, and engine room, 50 ft. 6 in. wide inside. Unlike the other buildings it has steel roof trusses, the minimum height to truss in the boiler room being 34 ft. 4½ in., and the maximum 38 ft. 9½ in., while the clear height in the engine room is 32 ft. These heights not only provide ample head room but assure better ventilation and a much pleasanter temperature for the attendants. All building, boiler and machinery foundations are concrete, on piling. The engine room is 8 ft. above the boiler room and under the engine room is a basement, the floor of which is 12 ft. below the engine room, and 4 ft. below the boiler room. The engine room floor is made of 12-in. I-beams spaced 4 ft. 10 in. centers, between and from the lower flanges of which are sprung brick arches. Over the arches is a concrete filling level with the tops of the I-beams, and bedded in the concrete are dove-tailed pine nailing strips placed so as to provide an air space between the concrete and the flooring. There are two courses of the latter, the first of which is 1-in. board laid diagonally. On this is laid ⅞-in. maple.

Coal is delivered on an elevated track on the north side of the building, from which it is dumped or shoveled from the car through a steel hopper and a crusher onto a trough-belt conveyor. This conveyor delivers to another conveyor running at right-angles to it and parallel to the boiler fronts, which elevates it to overhead bins, delivery to any bin being controlled by a movable trip. The last bin at the east end is for ashes. The conveyor system is that of John A. Mead, New York, and is driven, as is also the crusher, through a Renold silent chain gear by a 30-h.p. motor placed on the boiler room floor.

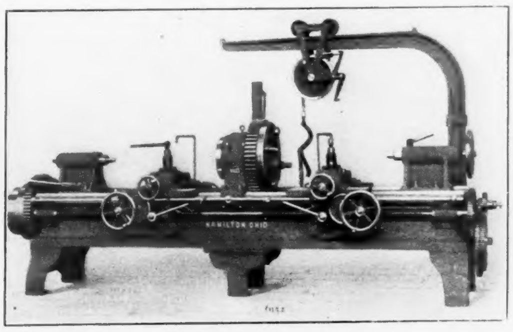
There are five 250-h.p. Edge Moor boilers having each 2,600 sq. ft. of heating surface and furnishing steam at 160 lbs. They are equipped with Murphy stokers, the Sturtevant induced draft system and Green economizers. The latter are placed on a steel trestle over the back ends of the boilers, and the draft fans are on an elevated platform at the east end of the room.

The engine room is equipped with two 300-h.p. Buckeye bored-guide, cross-compound, condensing engines running at 200 r.p.m., direct-connected to General Electric 210-k.w., 480-volt, three-phase, 60-cycle revolving-field, engine-type generators; one 150-h.p. Buckeye bored-guide cross-compound condensing engine, speed 257 r.p.m., direct-connected to a General Electric 110-k.w. three-phase generator; one 7 in. x 12 in. Buckeye bored-guide simple engine, 300 r.p.m., direct-connected to a G. E. 35-k.w. compound-wound direct-current, six-pole, 125-volt exciter; also a motor generator set composed of a 20-h.p., 440-volt three-phase injunction motor running at 900 r.p.m., direct-connected to a 13½-k.w., four-pole, 125-volt, direct-current generator, the whole being mounted on one cast-iron sub-base and connected by a rigid coupling. This motor generator set has capacity sufficient to excite the small unit, or, at an overload, to excite the two large units. The small three-phase unit is intended for lighting primarily, also for night and Sunday loads, and the motor-generator set will be used regularly to excite it. At the west end of the power station, in line with the electrical units, is an Ingersoll-Sergeant 1,300-ft. compound, two-stage air compressor delivering at 100 lbs. pressure. A 5-ton hand-power crane serves the engine room.



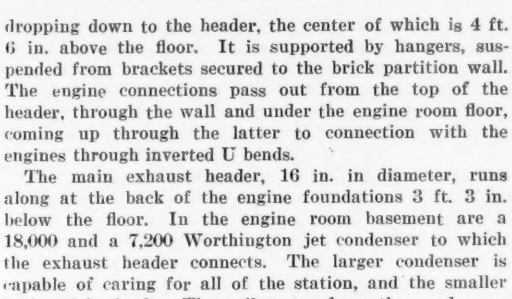
Typical Group Drive—Great Northern Shops.

Connections from the boilers to the steam header, which is 14 in. in diameter, are made through extra-heavy valves and fittings, and 7-in. pipe, the latter springing from the valves on the boilers in inverted U bends and dropping down to the header, the center of which is 4 ft. 6 in. above the floor. It is supported by hangers, suspended from brackets secured to the brick partition wall. The engine connections pass out from the top of the header, through the wall and under the engine room floor, coming up through the latter to connection with the engines through inverted U bends.



Niles Double Axle Lathe—Great Northern Shops.

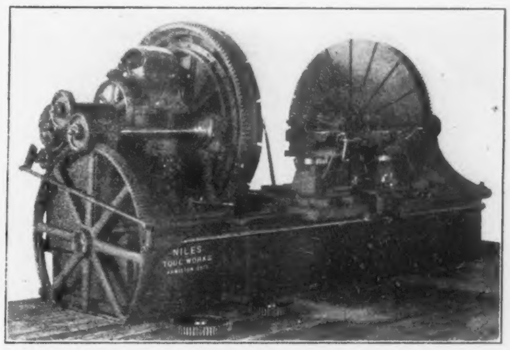
The main exhaust header, 16 in. in diameter, runs along at the back of the engine foundations 3 ft. 3 in. below the floor. In the engine room basement are a 18,000 and a 7,200 Worthington jet condenser to which the exhaust header connects. The larger condenser is capable of caring for all of the station, and the smaller is for light loads. The tail water from the condensers is pumped to a Worthington cooling tower, located at the east side of the building. The piping system is so arranged that the boiler feed water may be drawn from the condenser circuit, and connection from the city mains to a sump under the cooling tower is made for supplying losses. The exhaust header also has connection at its east end through a back-pressure valve to free exhaust through the roof. At the west end a connection is taken off to the Webster vacuum heating system.



Niles 48-in. Car Wheel Lathe—Great Northern Shops.

Running along beneath the 16-in. header is a 8-in. exhaust line, having connection to all of the engines and also to the 16-in. header beyond the last engine connection at the west end. This pipe will enable one or more engines to be put on the heating system, the large header being shut off from it, meanwhile, by a suitably-placed valve. The return water from the heating system also is used for boiler feed, the feed pump being a Blake compound duplex, 6 in. x 5 in. x 10 in., which may be run simple or compound. The Webster pump, the receiving tank for heating system returns, and the compressor intercooler are placed in the basement of the engine room.

Distribution.—Connections from the generators to the switchboard are run in armored conduit under the floor and bolted to the floor beams. The switchboard is made of 2-in. blue Vermont marble and has seven panels, there being one exciter panel, three generator panels, two power feeder panels and one lighting feeder panel; also the exciter panel provides auxiliary direct-current lighting for the power station alone. All alternating current panels have two-throw switches and two sets of bus bars to give entire flexibility. The board is equipped with a Lincoln synchronizer and a Tirrell regulator. The voltmeter and frequency meter are mounted on a swinging arm. All rheostats and transformers are mounted under the floor. Running out from the switchboard are six power and five lighting feeders, carried in boricated conduit under the floor, secured to the beams of the same. They pass west and then north to the mouth of the tunnel, which starts at the southwest corner of the boiler room.



Niles 96-in. Driving Wheel Lathe—Great Northern Shops.

The larger power feeders are 300,000 c.m., of which two go to the locomotive shop and one to the blacksmith shop. A smaller feeder goes to the boiler shop and the tank shop for the cranes in the latter. One feeder goes to the storehouse for the elevators and for the brass foundry motors. There is also a separate feeder for the motor driving the power station apparatus. Five sizes of conduit are used in the distribution, ranging from ¾ in. to 3 in. All service boxes used, of which there are three styles, were made from designs prepared in the mechanical engineer's office. At the junction of the tunnel lateral from the blacksmith shop with the machine shop tunnel is a switch cabinet provided with two double-throw switches and so wired that either the north or the south half of the shop can be thrown on either feeder. The distribution to all tools and lighting centers of distribution is underground.

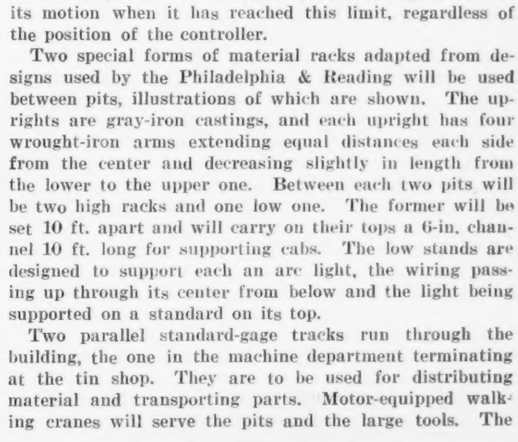
Machine and Erecting Shop.—This shop has 25 pits, spaced 24 ft. centers, one of which is equipped with a drop-table leaving 24 regularly available for repairs. The building, the area of which is 90,000 sq. ft., is divided equally into erecting and machine departments; however, 3,500 sq. ft. of the latter is partitioned off for use as a tin shop, reducing the machinery space to 41,500 sq. ft.

The erecting pits are 49 ft. long inside. The walls are composed of a base course of concrete, 2 ft. 6 in. deep, resting on piling, a 2-ft. course of rubble masonry and an 18-in. course of brick to which the track timbers are secured by ¾ in. x 18 in. anchor bolts. The bottom is paved with hard-burned brick laid on edge over a sand filling, and grouted.

The drop-table is the usual type raised and lowered by worm gears, the power being furnished by a 20-h.p. crane-type motor. A special device has been provided for limiting the table travel, the effect being to reverse its motion when it has reached this limit, regardless of the position of the controller.

Two special forms of material racks adapted from designs used by the Philadelphia & Reading will be used between pits, illustrations of which are shown. The uprights are gray-iron castings, and each upright has four wrought-iron arms extending equal distances each side from the center and decreasing slightly in length from the lower to the upper one. Between each two pits will be two high racks and one low one. The former will be set 10 ft. apart and will carry on their tops a 6-in. channel 10 ft. long for supporting cabs. The low stands are designed to support each an arc light, the wiring passing up through its center from below and the light being supported on a standard on its top.

Two parallel standard-gage tracks run through the building, the one in the machine department terminating at the tin shop. They are to be used for distributing material and transporting parts. Motor-equipped walking cranes will serve the pits and the large tools. The

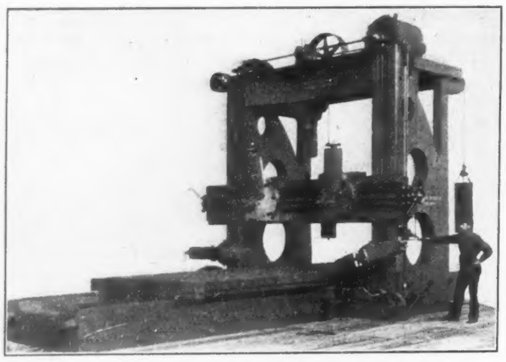


Niles Cotter and Keyseat Drilling Machine—Great Northern Shops.

latter are for the most part located between these two tracks. For all of the tool drives, both group and individual, General Electric Form K motors are used. The individual motors range from 3 to 30 h.p., there being two of each of these extreme sizes. There are 17 individually-driven tools in the machine shop, for which 7½

and 10 h.p. motors predominate. There are nine groups, including the tool and brass work rooms, with motors ranging from 5 to 15 h.p. The shop equipment is largely new. The accompanying drawing of the layout gives the groups and the names of the individual tools, and appended to this article is a list of the tools and groups with motor sizes.

South of the machine shop is a small frame building, octagonal in shape, 30 ft. in diameter. It is intended for removing tires from driving wheel centers and shrinking



Niles 84-in. Planer—Great Northern Shops.

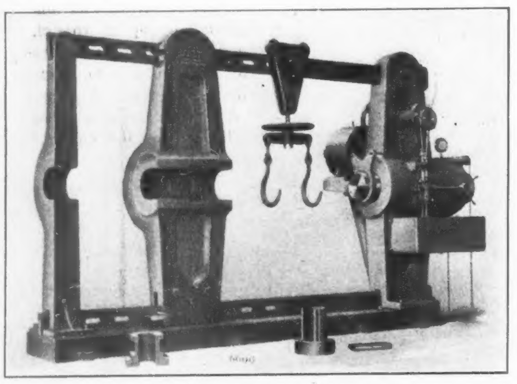
them on. It has a jib crane operated by a pneumatic hoist.

Boiler Shop.—This shop has 10 pits and a floor area of approximately 61,000 sq. ft. There are 11 tools, mostly individual driven. There are two sets of bending rolls, one 12 ft. 2 in. and the other 7 ft., which are driven from a counter-shaft belted to a 20-h.p. motor. There are also an oil-burning annealing furnace, and a 125-ton Niles hydraulic riveter, including pump, accumulator and 25-ton crane.

Tank, Truck and Flue Shops.—The tank shop occupies the south end of the building and is 87 ft. 4 in. wide. It has eight pits and is provided with crane facilities. Two spaces, each 45 ft. x 95 ft., east of the boiler shop, are set apart for truck and flue shops. The former has four pits, 31 ft. 4 in. long. The latter has the necessary equipment of furnaces and welders; also a cutting and a testing machine.

Blacksmith Shop.—This shop has approximately 40,000 sq. ft. of area. There are 45 blacksmith fires equipped with the Sturtevant exhaust system for removal of smoke and gases. There are 14 Ferguson oil-burning furnaces and seven steam hammers ranging from 600 to 4,000 lbs.; there is also one pneumatic hammer. The lighter tools are ranged along the south partition wall, there being two groups, one of which, including nut tappers, bolt-cutters, drills, etc., of which there are 14, is driven by a 30-h.p. motor, and the other, composed of four forging machines, is driven by a 40-h.p. motor. A cold saw, forging rolls, lever shear, bulldozer and a punch and shear are individually driven.

Storehouse.—This building is 452 ft. 4 in. x 100 ft. 4 in., and is two stories high. The west end for 52 ft. 8 in. is used as a brass foundry and is open to the roof. The east end for 41 ft. 8 in. is for offices. The foundations are concrete, and the wall and roof construction is similar to that of the shop buildings. All interior construction is wood, and over the store part of the building is a monitor with side lights, ventilators and skylights. The first floor is 2-in. plank nailed to 4 x 6 in. sleepers spaced 2 ft. centers and bedded in a dry sand filling. The floors are served with two electric elevators having platforms 6 ft. x 8 ft., and there are eight sets of floor scales, two of which are in the second story. On each side and on the west end of the house is a 16 ft. platform. Running around the building, in the middle of this platform,



Niles Hydrostatic Wheel Press—Great Northern Shops.

is a standard-gage track on which push cars and portable hoists may be run. East of the storehouse, 48 ft. distant, is an iron storehouse, 100 ft. x 200 ft., one-story high and having through its middle a track enabling cars to be run into the house for unloading and loading, the floor being on a level with the car floor. All heavy castings, sheet steel and bulky material will be kept here. The platform surrounding the storehouse is continued around this house and extended beyond, eastward, 322 ft.

An inter-communicating telephone system has been installed from the storehouse to all departments of the shops so that supplies may be ordered in this way. They will be delivered, with requisition made out for the foreman to sign. The telephone system will also be extended through the storehouse. The capacity of the new quarters is approximately four times that of the Jackson street storehouse.

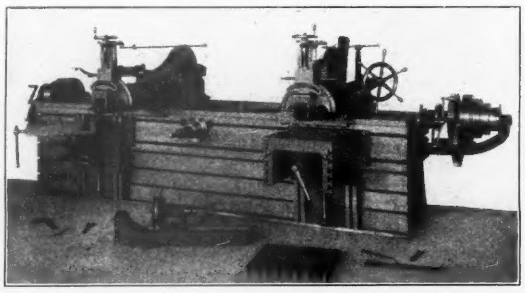
Laboratory.—This building, situated at the southwest corner of the property, is for the chemical and physical laboratories. It is a two-story brick structure 40 ft. x 60 ft. and will also contain the offices for the shops.

Transfer Table.—This table is 50 ft. long with a travel of 650 ft. Its capacity is 225,000 lbs., with speeds of 125 f.p.m. loaded, and 300 f.p.m. light. It is driven by a G. E. 20-h.p. Form M induction motor and was installed by Geo. P. Nichols & Bro., Chicago. It receives current from a trolley line carried on metal poles along the east side of the pit. The table travels on 56-lb. rails spiked to 8 x 12 in. timbers, bolted to concrete foundations 5 ft. deep and resting on piling. The filling between the tracks is sand.

Lighting.—For lighting there will be about 800 16-c.p. incandescent lights and 180 arcs, nine of which will be outside. The latter are to be G. E. Form 3 alternating-current, multiple, 110-volt, 60-cycle, long-burning enclosed arcs. In the shops each tool will have one incandescent light, or more if need be. A novel form of stand has been designed for these tool lights, an illustration of which is shown. The base is made of cast-iron and the upper part of ¾-in. wrought-iron pipe. They are bolted to the floor and the wiring comes to them in underground conduit. There will be in all about 180 of these stands.

The old shops at Jackson street will continue to be used as car shops for the present. The space resulting from the withdrawal of the locomotive department will be used for storage purposes and any needed expansion of the car department. The present main storehouse at this point will be used as a car department storehouse.

The Great Northern has only recently completed at Mississippi street, about a mile east of Dale street, a large coach yard having track room for about 126 passenger cars. Facilities are provided for cleaning, water-



Niles Double Head Shaping Machine—Great Northern Shops.

ing and supplying the cars with acetylene gas and with commissary supplies. The buildings, which are one story and built of brick, include a commissary building, 44 ft. 6 in. x 120 ft. 6 in.; storehouse, 73 ft. x 30 ft., with a roofed platform extending 32 ft. to the west; oil house, 24 ft. x 26 ft.; coal house, 20 ft. x 56 ft.; acetylene gas generating building, 102 ft. x 36½ ft.; and a boiler house, 56 ft. x 30½ ft. The yard is completely piped for steam, gas and air.

Tools and Motors in Machine Shop.
(Individual tools are classed as groups.)

Group No.	Machine.	Horse-power of motor.
1	Niles 300-ton hydraulic wheel press	7½
2	Quartering machine; 42-in. engine lathe	5
3	Niles 48-in. car wheel lathe	10
4	Niles 48-in. car wheel lathe	10
5	Sellers 54-in. x 54-in. planer	10
6	Niles 8-ft. boring mill	10
7	Niles 96-in. driving wheel lathe	10
8	72-in. driving wheel lathe	7½
9	Putnam 79-in. driving wheel lathe	7½
10	Niles 96 in. driving wheel lathe	3
	No. 7 Becker vertical miller,	
	No. 6 Becker vertical miller,	
	No. 2 Bement-Miles cotter drill,	
13	37-in. Niles boring machine	15
	30-in. Niles shaper,	
	24-in. Niles-Bement-Pond drill press,	
	No. 2 water emery grinder.	
14	Niles double axle lathe	7½
15	Niles single axle lathe	7½
16	Niles double axle lathe	7½
17	Niles 42-in. car wheel borer	7½
18	Niles 48-in. wheel press	5
	Gisholt standard "J" type turret lathe,	
	Gisholt standard "I" type turret lathe,	
	2-in. x 24-in. Jones & Laughlin turret lathe,	
	2-in. x 24-in. Jones & Laughlin turret lathe,	
	2-in. x 24-in. Jones & Laughlin turret lathe,	
24	2-in. x 24-in. Jones & Laughlin turret lathe	10
	20-in. Niles-Bement-Pond engine lathe,	
	Q. & C. cold sawing machine,	
	Niles four-spindle drill,	
	Diamond Machine Co.'s emery grinder,	
	Niles-Bement-Pond 24-in. drill.	
25	Pond 32-in. x 32-in. planer	5
26	Niles 30-in. x 30-in. planer	5
	Niles 22-in. lathe,	
	Lodge & Davis 18-in. lathe,	
27	Niles horizontal boring mill	5
	Niles 30-in. double-head shaper,	
	Gisholt 53-in. standard "K" type turret lathe.	
	Niles-Bement-Pond 12-in. pipe machine,	
28	Bignall & Keller 3-in. pipe machine	5
	Niles 19¾-in. shaper,	
	Niles 6-in. radial drill.	
29	Niles 60-in. x 60-in. planer	15
30	Pond 84-in. x 84-in. planer	30
31	Pond 48-in. x 48-in. planer	10
33	Putnam 36-in. x 36-in. planer	7½
	Niles-Bement-Pond 18-in. turret lathe,	
	Niles-Bement-Pond 18-in. turret lathe,	
	18-in. brass lathe,	
42	18-in. brass lathe	10
	Lodge & Davis lathe,	
	Fox 16-in. brass lathe,	
	Fox 16-in. brass lathe,	
	Diamond Machine Co.'s emery grinder.	
	Niles 18-in. lathe,	
	Niles 26-in. lathe,	
	Niles 26-in. lathe,	
	Niles 28-in. lathe,	
71	William Bement 12-in. slotter	15
	William Bement 16-in. slotter,	
	No. 5 Springfield oscillating surfacer,	
	Springfield face and variety grinder,	
	Bement-Miles shaper,	
	Niles 24-in. shaper.	
	Bement 50-in. drill press,	
	Bement 24-in. drill press,	
	Niles-Bement-Pond 21-in. drill,	
	Niles 18-in. extension lathe,	
72	Niles 36-in. engine lathe	15
	Niles screw machine,	
	Pond 28-in. engine lathe,	
	Fitchburg 32-in. lathe,	
	No. 2 water emery tool grinder,	
	Centering machine.	
	Total	310½
	Niles 18-in. lathe,	
	Niles 28-in. lathe,	
	Niles 24-in. x 48-in. gap lathe,	
19	Niles 24-in. shaper	15
	Niles six-spindle drill,	
	Niles four-spindle drill,	
	Bement-Miles 15-in. slotter.	
20	Niles 19-in. slotter	10
	Wright 16-in. lathe,	
	No. 2 Niles-Bement-Pond milling machine,	
21	Brown & Sharp milling machine	5
	Bement & Sons 9-in shaper,	
	Sellers twist drill grinder,	
	Niles-Bement-Pond cutter grinder.	
22	Niles 7-ft. boring mill	7½
	Gisholt universal tool grinder,	
	Gisholt turret lathe, "H" type,	
	Gisholt turret lathe, "H" type,	
	Lodge & Shipley 22-in. lathe,	
23	Pond 36-in. engine lathe	10
	Pond 36-in. engine lathe,	
	Niles 30-in. engine lathe,	
	Bement 32-in. drill press,	
	Niles-Bement-Pond 20-in. lathe.	

The Retirement of Mr. F. W. Webb.

BY CHARLES ROUS-MARTEN.

After a distinguished professional career extending to nearly 52 years, Mr. Francis William Webb, the eminent Chief Mechanical Engineer of the London & North Western of England, is to retire from active official duties on June 30.

Mr. Webb's engineering career may be said to have begun in August, 1851, when he became the pupil of Mr. Francis Trevithick, who was first locomotive superintendent at Crewe, and who also was the son of Mr. Richard Trevithick, generally regarded as "the father of the locomotive." At that time the locomotive department of the London & North Western was worked in three separate and practically independent divisions, but in 1862 all were amalgamated into one which had its headquarters at Crewe under the direction of the late Mr. John Ramsbottom. Meanwhile Mr. Webb had been appointed successively chief draughtsman, in 1859, and works manager in 1861. In 1866 he resigned his position to become manager of the Bolton Iron & Steel Works. In the summer of 1871 Mr. Webb gave up this appointment and went to America on behalf of the London & North Western to visit and inspect the principal railroads of the United States, the engines, rolling stock, and methods of working. Having completed this tour, he returned to Crewe as chief mechanical engineer in succession to Mr. Ramsbottom, who had retired. For some time Mr. Webb contented himself with mainly following the footsteps of his celebrated predecessor. Up to the year 1866, London & North Western express engines had always been of the single-driver type, those built since the year 1850 being either 7 ft. single-wheelers with inside cylinders 16 in. x 22 in., designed by Mr. McConnell for the southern division, or 7 ft. 6 in. single-wheelers with outside cylinders 16 x 24, the latter being designed by Mr. Webb's predecessor, Mr. Ramsbottom. It may be mentioned in passing that Mr. Webb has rebuilt and brought thoroughly up to date all these Ramsbottom singles which are still very useful, but all the McConnell singles were broken up many years ago. In the year 1866 the increasing weights of the trains induced Mr. Ramsbottom to try coupled express engines, and these he continued to build up to the time of his retirement. They had 6 ft. 6 in. coupled wheels and in-

side cylinders 16 in. x 24 in. Mr. Webb built a good many more of this class, but at the same time, as a result of the visit he had just paid to America, matured plans for a somewhat new departure. Up to that time, a large driving-wheel had been considered almost a necessity for express work, but on the trying section between Lancaster and Carlisle where the trains have to ascend at the rate of 1 ft. in every 130 ft. for many miles, winding up with nearly five miles of 1 in 75 to the summit on the top of the Shap Fells, the heavy Anglo-Scottish expresses by the West Coast route were often at a disadvantage, and double-heading became frequent. Mr. Webb had carefully observed the large use made in America for express service of engines having coupled wheels only 5 ft. 6 in. and even 5 ft. in diameter. He determined to try this plan on the North Western, but as a preliminary step he took a six-wheel coupled goods engine and removed the leading side rods, thus converting it into a four-coupled engine with 5 ft. 2 in. driving wheels, the cylinders being 17 x 24. Then used this engine for a lengthened trial on express duty with the result that it was found to do excellent work, and only a slightly larger driving-wheel diameter than 5 ft. 2 in. seemed to be indicated as desirable. Accordingly Mr. Webb designed and built at Crewe 20 engines which were similar to the standard 6 ft. 6 in. coupled type, but had wheels 1 ft. smaller, namely, 66 in. They proved so serviceable than 20 more were built, making 40 in all, and there is no doubt that they were remarkably handy and efficient little locomotives. After they had been running for a few years, however, it began to be thought that the wheels were too small for fast running, and so they were all converted into eight-wheel tank engines having leading and trailing radial axles.

In 1875 Mr. Webb brought out a new type of 6 ft. 6 in. coupled express engine known as the "Precedent" class. They were practically identical with the previously built 5 ft. 6 in. wheelers—which, by the way, were known as the "Precursors"—the only difference being the extra 12 in. in the driving-wheel diameter. Both these classes had larger boilers than the Ramsbottom engines, with a total heating surface of about 1,080 sq. ft., the steam pressure being 140 lbs. (subsequently raised to 150 and 160). He continued to build these engines until the year 1882, by which time 70 were at work, and here it may be said that in all probability no more thoroughly efficient engines, for their size and theoretical power, have ever run. Their performances have been consistently excellent, and often astonishing in view of their limited tractive force and small size. They are still doing valuable work on many of the London & North Western expresses. Some years later Mr. Webb not only rebuilt all the 6 ft. 6 in. coupled engines which had been built to his predecessor's designs, making them uniform with his own "Precedent" class, but also did the same for 90 very small engines with 6 ft. coupled wheels which he thus converted from nondescript weaklings into a serviceable type of express locomotive, they being in fact "Precedents" only with wheels 6 in. smaller, and therefore having by so much enhanced the tractive power. No fewer than 266 of these two classes of coupled engines are still in regular work. The so-called "rebuilding" was virtually a new building, for little was preserved of the older locomotives other than the wheel centers and number plates.

It was 21 years ago, namely, in 1882, that Mr. Webb took the important step which brought and kept his name so prominently before the public. He introduced the compound locomotive into England. It is true that casual and sporadic experiments had been made previously in this direction, but all had virtually come to nothing, and so Mr. Webb is undoubtedly entitled to the credit of being a pioneer in this important movement. After some trials of a small old engine which had been converted into a two-cylinder compound on Monsieur Mallet's system, Mr. Webb devised the system of compounding which bears his name. He adopted two high-pressure cylinders of small size placed outside the frames, exhausting into one large low-pressure cylinder placed inside the frames, the high-pressure cylinders driving the trailing wheels, the low-pressure cylinder driving the front pair of coupled wheels. The first engine of the class was designated "Experiment," and 30 in all were built during the years 1883-1884. It may perhaps be permitted to express a regret that Mr. Webb did not at the outset take the bolder departure which he found necessary in the year last mentioned. His "Experiments" were built mainly on the small lines of the non-compound "Precedents," but through the steam economy effected were able to haul somewhat heavier loads. They proved, however, deficient in speed, and as almost immediately after their appearance there was an important acceleration of the North Western expresses, they consequently came into disfavor and were speedily relegated to inferior work, while Mr. Webb promptly brought out in 1884 the first of the 60 larger three-cylinder compounds known as the "Dreadnought" class. These have done a very large amount of work, for being given a steam pressure of 175 lbs. they were able to use their nominal theoretical power to much greater advantage than "Experiment," which had only 160 lbs. Their smaller driving-wheels, 6 ft. in diameter, with the larger cylinders—14 in. high pressure instead of 13 in., and 30 in. low-pressure instead of 26 in.—gave them manifestly a vast increment of strength. The further increase of speeds demanded in 1888, the year of the "Race to Edinburgh," led to 10 more of these engines being built, which differed in having driving-wheels 1 ft. larger, namely, 7 ft. The engines "Ionic," "Adriatic" and "Jeanie Deans," which have gained worldwide celebrity on the strength of their various achievements, were of this class.

Next came a larger development of the same type, the "Greater Britains," one of which "Queen Empress"—was shown at the Chicago Exposition of 1893. They differed in having a very long boiler with midway combustion chamber and in having a pair of small trailing wheels behind the fire-box, thus they were eight-wheelers, of the "2-4-2" order. These, too, have done much good work, but all the three-cylinder compounds are occasionally at a disadvantage through temporary failure of synchronism between the high and low pressure "engines" owing to the driving wheels not being coupled and therefore being independent of one another. Only 10 of the "Greater Britains" were built; they were followed by 10 more, which were identical except in having driving-wheels 1 ft. smaller.

Up to this period exactly 100 express engines had been built by Mr. Webb on the three-cylinder principle, but the need for increased power was again felt, and to meet this he brought out a new type having four cylinders, two high-pressure outside, 15 in. x 24 in., and two low-pressure inside 20½ in. x 24 in., all driving the axle of the front coupled wheels. Increased boiler power and 200 lbs. steam pressure were provided. They came

out in 1887, the year of her late Majesty's jubilee, and consequently are known as the "Jubilee" class, the first bearing that name. They have since been followed by 30 more, which are identical but have considerably bigger boilers, water-bottoms to the fire-box and 16 in. high-pressure cylinders. These, too, have acquitted themselves favorably with heavy loads, but it is understood that reductions alike in the steam pressure and in the high-pressure cylinder diameter have been made with advantage in some cases, and may possibly be applied to all of them.

Beside these compound express engines, Mr. Webb has built a large number of freight engines on each of his two systems—three-cylinder and four-cylinder. They have cylinders of the same dimensions as the express engines, but run on eight wheels, all coupled, 4 ft. 3 in. in. diameter. They haul heavy loads and are said to work with marked economy.

The tank engines used by the London & North Western are numerous, and the three-cylinder method of compounding has been tried experimentally in three or four cases, but apparently with unsatisfactory results, as all the tank engines built for some years, which are of several different classes, are on the non-compound principle.

Although Mr. Webb is known chiefly by his locomotives, he has done valuable work in several other departments of mechanical and electrical engineering. It would occupy by far too much space to give even a bare list of his inventions and their application. It must suffice to say in general terms that the Chief Mechanical Engineer of the London & North Western Railway has left an ineffaceable mark on the engineering history of his time.

The mileage of the Austrian railroads increased 297 miles in 1902, to 12,693 miles, 57 per cent. of which belongs to the State.

The Standard Code on the C., N. O. & T. P.

Vice-President W. J. Murphy, of the Cincinnati, New Orleans & Texas Pacific, has lately issued a new book of rules containing a revision both of the Standard Code and of the other parts of the train-rule code of that road. The last code issued by this road came out in 1897 and was based on the Standard of the American Railway Association as it existed at that time. The present issue embodies the principal changes that have been made by the association during the six years that have since elapsed. The "general notice" is quite different from that in the standard. The "general rules" are about the same, and the "definitions" conform to the standard. Rule 12, dealing with hand, flag and lamp signals, has the illustrations with the rule and not in an appendix; and to the usual illustrations there have been added one (*f*) showing a man with the arm raised above the head (the signal which in England indicates caution) to indicate "proceed," and one (*g*) with the right arm extended horizontally (the English all-right signal) to indicate caution. These are, of course, usable only by day.

Rule 14, paragraph *n*, provides for one long and one short sound of the steam whistle to be used on a freight train to indicate the approach to a meeting point; rule 16, paragraph *i*, provides for two long and one short sound on the air whistle, for the same purpose, on passenger trains. Following rule 33 are the block signal definitions and the rules for (1) automatic block system, (2) interlocking, and (3) the electric staff block system. There are no rules for the telegraph block system and the block signal rules which are shown are quite brief as compared with those of the Standard Code. These rules are numbered from 41 to 74 inclusive.

In Rule 89 inferior trains are required to keep 10 minutes off the time of superior trains running in the same direction. In Rule 90 conductors are instructed to use the air whistle signal *i*, referred to in Rule 16. In Rule 91 the interval for passenger trains is 10 minutes; for other trains 15 minutes by day and 20 minutes by night. (This road is pretty well equipped with automatic block signals, making rule 91 almost unnecessary.) Rules 99 and 99*a* fill nearly two pages. Three different distances are given for the flagman to go back, the distance on a down grade being 35 telegraph poles. Rule 99*a* requires all except first-class trains to be under control approaching watering stations, coaling stations and stations where yard limits are established.

Rule 207 provides for "31" orders, but no mention is made of Form 19. Rule 221 provides for a train order signal normally indicating "stop." The next thing following the train-order rules is a chapter on "special order books," which are kept at certain places on each division and abbreviated copies of which have to be carried by each conductor and engineman.

The "general regulations for employees," filling about 80 of the 130 pages of the book, have instructions for the chief engineer, for superintendents, and for a number of other officers in addition to the usual classes of train and station men, etc. This latter part of the code, what may be called the unstandard part, is of somewhat unusual interest by reason of its origin. In 1894, a committee of the American Railway Association reported a code of rules for this part of train and station work (the part not covered by the Standard Code) which was never adopted. The members of the committee could not themselves agree to recommend their code for adoption, and the sentiment of the Association appears to have been, in substance, that uniformity in these matters was either impracticable or unnecessary. But the rules embodied, nevertheless, two important elements; first they included all of the ideas to be found in any American code which could be classed as useful for railroads in general, (the decision as to usefulness being that of a competent editor, Mr. C. A. Hammond); and, second, they were written in simple and lucid English. The omission of the word "they" in telling what certain classes were required to do was one commendable peculiarity. This committee-report, though never acted on, was, however, recognized in some quarters as a product of conscientious work, and a prodigious amount of it, carried out according to a rational plan; and the Cincinnati, New Orleans & Texas Pacific adopted the rules in a body, making few additions and few changes and excisions.

No one would assert that these rules had any radical defect except excessive length and detail; and we never heard any affirmative argument against them, even on that score. They failed of general adoption, and that fact is presumptive evidence of dissatisfaction with their large volume; but up to the present time no one who has carefully examined the rules has formulated any specific criticism either of their form or their substance. The code now under review (a revision of the C., N. O. & T. P. code of 1897), does, however, constitute a critique on Mr. Hammond's work, as numerous changes are made in the language. Without going into an examination of the merits of these changes, we reprint a large section of the new code, with which the reader can make comparisons for himself. The rules as they were formulated in 1894 may be found in the proceedings of the American Railway Association, vol. 2, p. 176.

One other road, the New York, New Haven & Hartford, in its code of 1899 made use of a good deal of this material, but except on these two roads we do not recall any use of Mr. Hammond's work. For ourselves, we believe that it is a good thing to arrange in formal fashion these rules of secondary importance. Most Amer-

ican superintendents, enamored of their time-honored brevity, will, perhaps, say that we are giving too much prominence to mere words; but we do not admit the charge. The English railroads have got along fairly well during the past 25 years, and they draw on the dictionary much more liberally than has been done in this case.

The changes which have now been made by Mr. Murphy seem to have been mostly in the nature of eliminations and condensations. Possibly this action by him is evidence of unsoundness in our view; but we are willing to have the reader who has his old code and who compares it with the new, decide this point for himself. The essential thing in a rule is to convey an idea to a trainman's mind. The advocate of brevity merely prefers to convey the idea in some other way—by oral instruction or by trusting that the men will successfully pick up the necessary knowledge in their own way. The gist of the argument in favor of fulness in rules is that the oral or other instruction should have the advantage of a uniform pattern or guide.

The type used in this new code is much smaller than that in the 1897 code and this in itself seems to condense the matter, though it does so only to the eye; not necessarily to the mind. In the present book the column is almost exactly the same width as that of the *Railroad Gazette*, and the type is only a trifle larger than that which the reader sees in the reprint below; whereas the 1897 code took about a half more space for the same number of words.

[*Extract from Rules of Cincinnati, New Orleans and Texas Pacific Ry.*]

CONDUCTORS.

General Instructions.

601. Conductors will report to and receive their instructions from the Superintendent. They will obey the orders of the Trainmaster, Station Master and Agent, within their respective jurisdictions. They will carry out all instructions issued by the Accounting, Passenger, Freight and Treasury departments.

602. They will have the general direction and government of the train and of all the men employed on it.

603. They will be familiar with and enforce the rules applicable to all employees on the train, reporting any insubordination, misconduct, or neglect of duty of enginemen, firemen, baggagemen, brakemen, porters, sleeping car conductors, mail agents, express messengers, and news agents. They will suspend any employee on the train for gross misconduct or disobedience of orders.

604. They will require all subordinates to be well instructed in their duties, warning them of the special personal dangers connected with their work.

605. Inasmuch as many accidents have resulted from failure to protect trains properly, therefore, they will invariably require flagmen to act with the utmost promptness and in strict accordance with the rules, and will never entrust such responsible duties to an inexperienced man unless in case of absolute necessity, when the fullest instructions which the nature of the emergency will permit must be given.

606. They will report, with the necessary trainmen, signals, and supplies, 30 minutes before train leaving time and if necessary assist in making up the train.

607. When reporting for duty they will provide for themselves and for all trainmen under their control copies of the current time-table.

608. They will see that the train is properly made up, and inspected before starting and as often as possible during the trip, and that all air-brake, air-signal, and other tests are made before starting and also at every point where the make-up of the train has been changed, crossings opened, engines detached, or where, from any other cause, it has been necessary to disconnect the air-brake or air-signal.

609. They will examine the bulletin board and Special Order Book before starting on each trip.

610. They will personally enter in train registers all information which the form requires.

611. They will keep in the train book a record of important occurrences, and be prepared to give a full and detailed account of them when required.

612. At the end of each trip they will make all the required reports, with neatness and accuracy, and forward them promptly to the proper officer.

(*a.*) When accidents occur they will take entire charge of all necessary work, in the absence of the Superintendent or other officer, and may command the services of employees. When accidents occur, involving the loss of life, serious injury to persons, or damage to property, or obstruction of the road, they will telegraph the Superintendent as full details as possible immediately.

(*b.*) In addition to telegraphic reports they will make written reports to the Superintendent of all accidents, including defect and failure of engines, bridges, or roadbed, and of any stock that may be killed, and will procure the names and addresses of witnesses with as much testimony as possible relating to personal injuries.

(*c.*) They will call the company's surgeon, when available, and when not available, any other surgeon may be called when necessary.

614. When, under instructions from the proper officer, one conductor relieves another before the completion of the trip, the relieving conductor shall, by conference with the conductor relieved, make himself thoroughly acquainted with the orders taken over by him. He will, also, compare these orders with those in the hands of the engineman before proceeding on the trip.

615. When Special Orders, notices, or supplements to the timetables affecting the movement or safety of trains are received, they will have the brakemen read and understand them.

616. They will command the services of engines and men on trains of inferior class, should the emergency require.

617. Should there be any reason to believe that the train has passed over a dangerous defect in the roadway, they will stop the train at once. If the roadway is not safe, they will leave a brakeman, who must go back with signals to warn following trains.

618. They will leave cars on sidings in safe order—wheels blocked, brakes set, and derailing switches open.

619. If two or more trains are working over the same switches the senior conductor will be in charge.

620. They will exercise the greatest care concerning the hand, lamp, flag, and detonating signals required by the train rules. They will see that such signals are carefully made, correctly placed, and promptly shown, as occasion requires, and know that all needed signal supplies are constantly kept on the train and in good condition for immediate use. They will not give, or permit trainmen to give, hand or lamp signals in a careless or uncertain manner. They will have three (3) torpedoes attached to each red lantern at night.

621. They will watch for signals when leaving or passing stations, and when passing other trains, trackmen, bridgemen, signalmen, and block stations and will instruct trainmen to do the same.

622. During and after an extraordinary rainstorm, or high water, they will stop the train and send a man in advance to examine bridges, trestles, culverts and other points in the road liable to danger, and will assure themselves of the safety of the same before allowing trains to pass over. They will make careful inquiry at all stopping places, and when thought advisable make extra stops, to ascertain the extent and severity of the storm.

When in doubt as to the safety of proceeding they will place the train upon a siding and remain there until certain that it is safe to proceed.

623. Where there is no night operator, they will, when necessary, call the day operator to get orders.

Passenger Conductors.

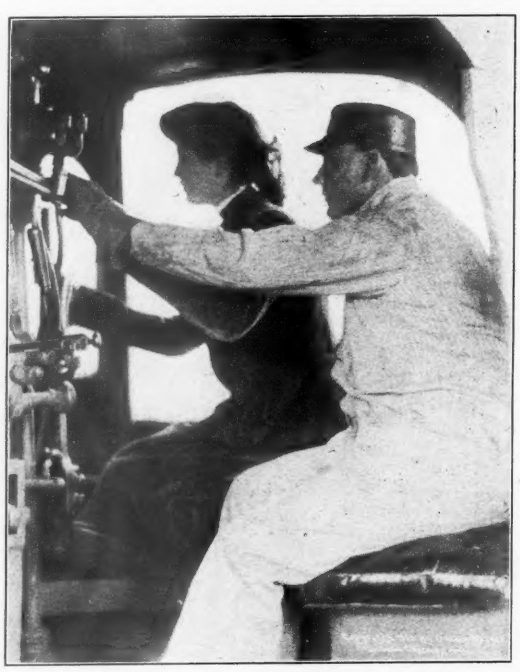
651. They will attend to the comfort and convenience of passengers, the preservation of order and decorum upon the train, and the maintenance of good discipline among the men employed thereon. They will require every man to be neat in person and orderly and respectful in conduct.

652. When trains are at terminal stations they will have all trainmen in uniform at their respective posts to assist passengers and to give necessary information.

653. Before starting from a terminal station they will examine each car and see that it is in a clean condition.

654. They will see that the number of cars is sufficient for the accommodation of the passengers. Should there not be sufficient sitting room in the coaches during the day to accommodate all the passengers, some of them may be seated in sleeping or parlor cars. This should not be done when the passengers in sleeping cars have retired, or to such an extent as to inconvenience sleeping car passengers. The sleeping or parlor car conductor should be given a report of the number of passengers placed in his cars and the stations from and to which they travel.

655. They will not start the train from an inspecting station until the inspectors have given notice that their work is finished, nor from any station until all movement of passengers to and from the cars has ceased and the signal has been given by every trainman. After the train has started they will not permit passengers to get on or off. They will bring the train to a stop before passengers are permitted to get on or off.



A Locomotive Engineer's Brotherhood.

656. At way stations, the signal for starting the train must be given from the station platform. They will not enter offices at way stations except for train orders, or to examine the bulletin board, Special Order Book, or train register.

657. At terminal and meal stations, when there is no train caller, they will announce distinctly in the waiting and dining rooms when the train is ready to leave, giving destination, etc.; at junctions, they will call from the station platform "All aboard for ———," naming destination.

658. If the train should run past a station, they will notify passengers not to get off until the train has backed, which movement must not be executed until the conductor has given the proper signal. This shall be acknowledged by the engineman by three short blasts of the whistle. Whenever a train thus runs backward the conductor or brakeman must be on the rear platform of the last car.

659. They will see that each car is aired before starting and well ventilated on the trip; the water coolers well supplied; the temperature, in cold weather, kept warm and comfortable; water closets kept unlocked except at terminal stations; the lamps in good order and at night giving a good light; the seats turned the right way, and the floors free from dirt or refuse of any kind. When the cars are to be cleaned at points where no cleaners are employed they will see that the trainmen faithfully perform this work.

660. They will not permit trainmen to be familiar with passengers, sit in seats with them, or converse with them further than duty requires.

661. They will allow no unauthorized person to solicit business for any hotel, firm or transportation line.

662. When notice is received to reduce speed at given points, they will require the engineman to keep within the speed limits ordered.

663. Immediately upon arriving at a terminal station they will go through each coach with a trainman and carefully look for anything left by passengers. Every article found, unless it can be delivered immediately to the owner, must be sent without delay to the general baggage office, properly tagged, with date, train number and name of finder.

664. They will permit no persons except the authorized news agents in uniform to sell books, papers, etc., on trains. Such agents will be under the conductor's control, both as to their methods of work and the character of the matter offered for sale. They must conduct their business in a quiet and orderly manner, without passing through the cars too frequently, and without annoying the passengers. Any rudeness, familiarity or ungentlemanly behavior will be sufficient ground for conductors to immediately revoke their privileges and report the case to the Superintendent.

665. They will make as little noise as possible in and about sleeping cars at night.

666. They will not allow passengers to ride on the car platforms, in the baggage, express or mail cars; to put feet on the seats; to occupy with their baggage, seats needed by other passengers, or to damage, in any way, the property of the Company.

667. They will not permit drunken or disorderly persons to get on trains nor allow disorderly conduct on the part of any passenger. They will promptly repress any disturbance, gambling, threatened violence or profane or offensive language by ejecting the offender.

668. They will require a ticket, pass or cash fare from every person, except children under five years of age, the train crew, the officials of the road and such other persons as the Superintendent may designate. Half fare will be collected from children from five to twelve years of age, inclusive.

They will collect regular ticket rate—

1. When passengers board trains at regular or flag stations where tickets are not on sale.

2. When passengers board trains where ticket offices are not open a sufficient time to admit purchase of tickets. (Note on report to Auditor, "Ticket office not open.")

3. When the agents have found it impossible to issue tickets to passengers on application.

(Agents will, in each case, notify the conductor of failure to furnish ticket under conditions shown in paragraph 3.)

They will collect train rate—

1. When passengers board trains without tickets at stations where ticket office is open.

(It is preferable to collect fares to next stop ONLY and to request passengers to purchase tickets to destination there.)

2. When passengers hold tickets short of their destination, whether the train on which they take passage stops at the station to which their ticket reads or not, fare should be collected from the point to which their ticket carries them to the next station stop, and holder of said ticket should purchase a ticket to destination there.

3. When passengers hold invalid tickets.

4. When passengers board train without tickets at stations where trains are not scheduled to stop.

5. When passengers have not sufficient money to pay train rates to desired destination, train rates will be collected, if passenger has sufficient money, to the next regular stop.

669. As soon as the train starts from a station they will pass through every car for the collection of tickets and fares, and will cancel each ticket or trip pass by punching it at the time it is lifted. They will take up local tickets, good for passage within the limits of their run, when first presented.

670. They will collect no fares beyond the limit of the run assigned, and will not accept coupons that are detached from tickets unless passengers exhibit remainder of the ticket.

671 (*a*). When examining tickets they will instruct passengers destined to points on connecting lines where to find their trains at the junction point and give them any other information that may be necessary for their guidance.

(*b.*) If a passenger boards a train destined to a station at which the train is not scheduled to stop, he may be carried to the first station beyond that point at which a stop is made and sent back, free, to his destination.

(*c.*) When passengers in sleeping cars have retired the collection of tickets, passes or fares will be made by the sleeping car conductors and held subject to the call of the train conductor, who will carefully check them with the car diagram to see if an equivalent is received for each seat or berth occupied.

672. They will collect full fare or a first-class ticket for the transportation of the body of a deceased person, provided it is properly prepared and boxed and accompanied by a necessary certificate of burial or removal.

673. When acting as a railroad police officer, and, therefore, authorized to arrest without a warrant, a passenger who persists in being noisy or disorderly, or who is otherwise offensive, or who is intoxicated, or who on demand refuses to pay fare, they shall see that the statutes made and provided for such cases are fully complied with that no unnecessary force or other impropriety in official conduct is exhibited, and will obtain the names of several passengers as witnesses, to be sent to the Superintendent with a full report.

674. In the exercise of sound discretion, should it be necessary for the reasons mentioned in Rule 673, to remove a passenger from the train, they shall observe the following precautions: Use no more force than is absolutely necessary; maintain a dignified self-control in the discharge of such duty; eject, whenever practicable, only at a regular station and where there need be no exposure to inclement weather; never endanger the life or safety of a passenger or eject a child of tender years or a person of unsound mind or in a feeble or helpless condition; and always obtain the names of several witnesses, to be sent with a special report to the Superintendent, giving full particulars.

Freight Conductors.

701 (*a*). Before leaving terminal stations, and whenever the train stops for any length of time, conductors will examine seals and locks on both sides of all cars in their train.

(*b.*) When the seal of a car is cut at a non-agency station they will re-seal the car before leaving and make a record thereof. Cars taken from non-agency stations must be sealed at the billing station.

(*c.*) The seals on cars in way freight trains must be broken by the conductors, and the agent and conductor will jointly check all freight delivered to or from the train. When cars from which freight has been partially unloaded are left at a station before the destination has been reached they will (unless they already bear seals) be sealed and locked by the agent in the presence of the conductor leaving them.

(*d.*) They will report to the Superintendent accidents to cars necessitating cutting of seals; also when seals are found to be broken.

702. They will not move cars that are improperly or too heavily loaded, or not in safe condition to run. When necessary to leave such cars at stations they will fill out and attach to the waybill "Bad Order Car Report," leaving it at first open telegraph office.

703 (*a*). Cars containing oil, gunpowder or other highly inflammable substance must be placed at least four cars from the caboose.

(*b*). If two or more locomotives are taken as freight in one train they will place them at least three cars apart.

704. They will deliver to the Station Agent, or Yardmaster, a waybill for each car left. Should there be no Agent or Yardmaster at such point, they will deliver the waybill to the next Station Agent.

705. When freight or empty foreign cars are moved from a station where there is no agent, they will report the matter to the next Station Agent beyond and have proper waybills made.

706. They will not move any loaded car without a waybill or on a waybill that has been altered unless it shows on its face by whose authority the alterations were made.

707. When freight is transferred from one car to another they will write on the face of the waybill the reasons for such transfer, the condition of the freight, the station name where transfer is made and the initials and number of the car to which the freight is transferred, drawing a pencil mark through the original car number and initials. The name of the person making the transfer must be signed to the statement.

708. When loading way freight they will see that the car number and initials are shown on the waybill furnished by the agent.

709. When loading way freight they will, as far as practicable, arrange it in such way as to make full car loads.

710. If there is no agent where freight is left, they will check off upon the waybill all goods left and on the face of the waybill certify to their correct delivery and apparent condition, mentioning particularly any damaged or missing freight. They will make a notation of the condition of the weather and whether or not any one was present to receive the freight. If owner or his representative is present, they will take his receipt therefor on the face of the waybill.

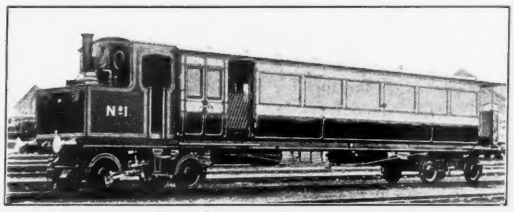
711. When it is necessary to move cars, they will warn persons employed in or about them to be on their guard against possible danger.

712. When handling live stock they will be governed by the Revised Statutes of the United States, which fix the conditions under which live stock may be transported. The Statutes applicable here follow. [Omitted. —EDITOR.]

Steam Motor Cars for the London & South-Western.

There have been a number of steam motor cars illustrated from time to time in the *Railroad Gazette*, which were built for service on isolated lines in this country. Reproduced herewith are the drawings of an English design, by Mr. Dugald Drummond, Locomotive Superintendent of the London & South-Western Railway, as published in *Engineering*. One of these cars has been built and is now being tested on one of the suburban divisions of the South-Western between Fratton and Southsea. Fig. 2 is part side elevation, showing the boiler and engine truck; Fig. 3 a front elevation, and Fig. 4 a part plan. The car is carried on two four-wheeled trucks, the leading one being extended to form a support for the boiler. The wheels have inside journals, the truck frames being inside of the wheels. The frames are solid and supported over the journals by half-elliptic springs resting on a saddle. Contrary to the usual design of similar machines in this country, the cylinders are connected to the leading wheel. They are 7 in. x 10 in., and are mounted on an incline of one in 10. The driving wheels are 33 in. in diameter. An outside valve motion is used of the Walschert type. This arrangement gives a compact engine, easily accessible for cleaning, examination or repair. The boiler, which is suitably mounted on the engine truck, is of the vertical type, with inclined water tubes in the fire-box. It has 5 sq. ft. of grate area, 130 sq. ft. of heating surface, and an inside diameter of shell of 3 ft. The steam pressure is 150 lbs. to the sq. in.

The underframe of the car is of steel and extends the entire length of the vehicle, the total length being 53 ft. 5 in. The extreme width is 8 ft. 1 in. The trucks have a wheel base of 8 ft. and a distance between centers of 39 ft. 11 in. From the top of rails to the top of carriage is 12 ft. The total weight is 29 tons. The body of the car is divided into two compartments, accommodating



Steam Motor Car—London & South-Western.

14 first and 32 third-class passengers. In the first-class compartments the seats are arranged longitudinally, and in the third-class compartment the seats are arranged in pairs transversely with a center aisle. There is also a small baggage compartment which holds about one ton. Another design of the car has been prepared omitting the baggage compartment and giving a seating capacity for 46 third-class and 8 first-class passengers.

Fig. 1 shows the acceleration diagram for this car. It

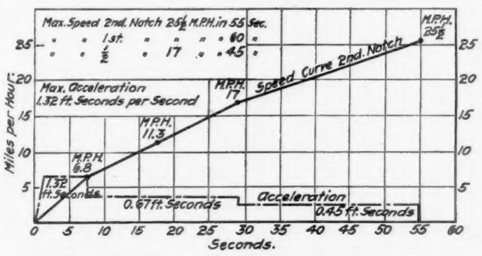


Fig. 1.—Speed and Acceleration Curves.

Steam Motor Car—London & South-Western.

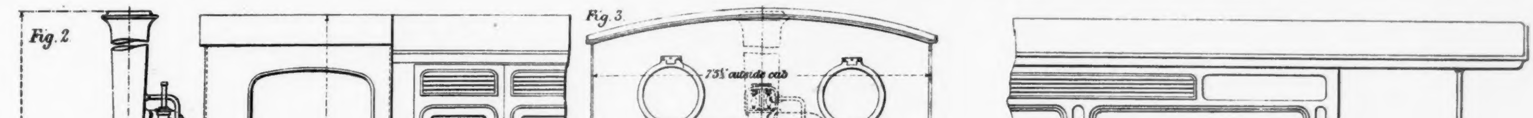
is proposed to run the car at a regular rate of 25 miles an hour, and from the diagram it will be seen that this speed may be reached in less than 54 seconds from rest. Connections are made so that the engine and boiler may be controlled from either platform.

This latest attempt on the part of steam roads to compete successfully with the electric lines for the business of comparatively sparsely settled territory is likely to meet with the same objections, which have made all use of self-propelled cars in this country practically out of the question. The results of the introduction of this type of car on the suburban lines of the South-Western will be watched with some interest, since the cars are intended to compete directly with a parallel electric line, and if they can successfully hold a fair share of the business for the railroad company, doubtless more of them will be built. The railroads have a decided advantage over the electric lines in that they have the easy gradient, adequate signaling protection, well equipped stations and the organization and management generally, and trains can run at much higher speeds owing to private rights of way and better roadbed, but this advantage is offset by the excess of cost of operation of long trains. Frequent service and low fares are the weapons of competition used by the electric lines and the railroads have not so far been able to hold their own.

Coal Contracts Need Not Be Shown.

Judge Lacombe in the United States Circuit Court at New York has handed down an opinion in the application made by the Interstate Commerce Commission against the coal carrying roads to compel witnesses to produce certain contracts and answer certain questions. Judge Lacombe sustains the position of the railroads in every particular except in one minor instance. The opinion says that the questions raised have to be treated de novo; the court does not sit as an appellate tribunal. "In view of the language of the Interstate Commerce acts there is great force in the contention that the prosecution before the Interstate Commerce Commission of carriers who violate the statutes should be at the instance of the shipper, and that an individual who merely purchases merchandise, the price of which is advanced by reason of its being included in the cost of transportation from the place of production to the place of sale, may not institute and prosecute such a proceeding where no shipper raises any objection to the rates charged. In view of the other grounds of objection which have been interposed, however, it will not be necessary to decide this question."

The first case considered is that requiring D. G. Baird to produce contracts for the purchase and transportation of anthracite coal; all contracts between the Lehigh Valley Coal Company and any producer or mine operator. This company is owned by the Lehigh Valley Railroad Company. "One of the contracts asked for has been produced and submitted to the court, and it does not provide as indicated in the petition that the 'prices paid to the seller are certain percentages of the prices for which the coal is sold at tidewater terminals.' It is entirely a contract of purchase and does not deal at all with the subject of transportation. It fixes the price which the Lehigh Valley Coal Company is to pay the seller for coal at a certain percentage of the price at which coal of the same quality and sizes shall be sold during the month at a specified place. It is no way different from a contract for the purchase of a specified number of tons of coal at a specified sum in dollars and cents; a contract made in the State of Pennsylvania and to be completed therein by the delivery of coal at the breakers." . . . This particular contract is not relevant to the question of reasonable rates, discrimination, etc., which was presented by the complainant. The petition to direct the production of this contract is therefore denied. "If, however, there are any contracts in the possession of the witness



Steam Motor Car—London & South-Western.

which deal with the subject of transportation as well as with the subject of purchase, they should be produced."

A similar decision is reached in the case of Fred F. Chambers and many others.

In the case of Edgar C. Hubbard, Secretary of the Guaranty Trust Company of New York, who was asked to produce contracts referred to in the hearing as "The Temple Iron Company contracts," the court says:

"It appears that heretofore certain coal operators and coal companies, which were not owned or controlled by the defendants, being dissatisfied with the freight rates or with the manner in which the business of transportation was being conducted came together for the purpose of building or securing the building of a new road from the coal regions where their mines were located to tide-water. The defendant being unwilling to meet the competition which such a new road would introduce, combined together and bought up the collieries of those who were promoting the new road. Thereupon the project of building such competing road was abandoned. The contracts in question are parts of the machinery by which this combination prevented the building of the new road. If the defendants were being prosecuted under the Sherman Anti-Trust Act for having entered into a combination, agreement or contract in restraint of trade, the contracts in question would be relevant testimony. This, however, is not a prosecution under the Anti-Trust Act, nor is the Interstate Commerce Commission the forum before whom such a prosecution is conducted."

The court denies the motion to require the production of these contracts upon the ground that they are irrelevant to the proceedings. E. B. Thomas, President of the Lehigh Valley, need not answer the questions put to him, because they relate wholly to the sale and not the transportation of coal.

The one instance wherein Judge Lacombe orders a question answered is in the case of President William H. Truesdale, of the Lackawanna road, who was asked, "What elements or expenses are included in the item of $91,321.55 for general expenses?" The court decides that as the document containing that item is in evidence before the Commission the witness should answer.

Tendencies in Locomotive Design.

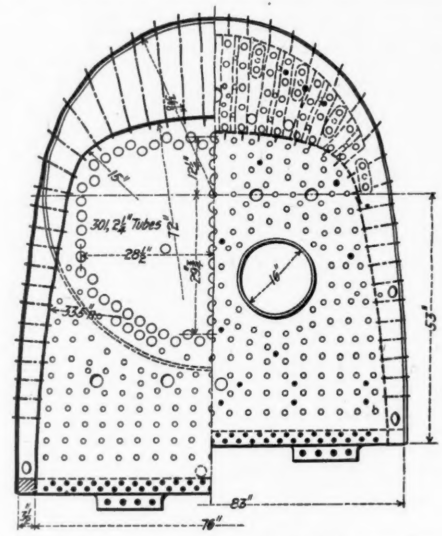
[WITH AN INSET.]

Many believe that the diversity of wheel arrangements has been due chiefly to the whims and fancies of the designer. In a few special cases, this has perhaps been true, but in general, the use of a certain wheel arrangement for a locomotive designed for a given service is determined by the character of the service and by the necessity of having a correct relation between the capacity of the boiler and the cylinder power. The development of the locomotive has been chiefly along the line of increased size and power in response to the demands for heavy train loads and high speeds. The power of the boiler has increased at a greater rate than the power of the cylinders, so that the modern locomotive has a high steaming capacity. In order to keep the total weight of each engine within certain fixed limits, it has been necessary to pay close attention to the detailed design of the several parts so that the greatest possible weight could be placed in the boiler. Cast steel has been substituted for cast and wrought iron and the wheel arrangements have been modified to accommodate the powerful boilers with their large grates and wide fire-boxes.

The condition of the track and roadbed is often the limiting factor, and it may be impossible to use the wheel arrangement best adapted to the service. With modern heavy rails, well ballasted track and heavy bridges, it is considered good practice to allow the load upon a single pair of drivers to approach 50,000 lbs. In a few cases this limit has been slightly exceeded. On a road having many sharp curves, the maximum allowable rigid wheel base may be the controlling element, while in other cases where the line is built across open and exposed places, the resistance caused by severe cross winds may call for a design of locomotive much more powerful than would otherwise be needed. Taking all these factors into consideration and knowing the weight of train to be hauled and the maximum controlling grade, the designer can estimate with a fair degree of accuracy the maximum drawbar pull which the locomotive must exert. If the engine is for passenger service where rapid acceleration is required, then the maximum drawbar pull necessary to overcome the total train resistance must be increased by an amount depending upon the desired rate of acceleration. In freight service there is less necessity of having a large reserve tractive effort as acceleration is less important, and by modern tonnage rating methods, freight locomotives are loaded to about their maximum capacity. Assuming, however, that the maximum drawbar pull is settled the next consideration of the designer of a locomotive is to fix the weight on drivers. The average value of the coefficient of friction between the driving wheels and rail is generally taken at 25 per cent. on good track. Hence multiplying the tractive effort by four gives the required weight on drivers. Assuming further that the maximum allowable weight on one pair of drivers is 50,000 lbs., then by dividing the total weight on drivers by 50,000 gives the number of driving axles. Thus if the total weight on drivers is found to be 135,000 lbs., the number of driving axles would be 135,000 divided by 50,000, which is greater than two and less than three. Hence three pairs of drivers are required. The diameter of the drivers is then determined, depending upon whether the engine is for high or low speed service, and the cylinder dimensions can then be computed from a knowledge of the boiler pressure, size of drivers and tractive effort.

The only remaining fundamental feature of the design is the size and power of the boiler and the relative proportions of its several parts. The boiler will evaporate the greatest amount of water when the maximum trainload is hauled at the highest speed. Knowing then the speed at which the engine must work, together with the other factors already calculated, the maximum power developed by the boiler is determined. The design of the boiler then becomes a separate problem, the heating surface, grate area, etc., being proportioned according to certain rules laid down by experiment and practice. The next really difficult part of the design comes in assembling the several parts. The total weight must be kept within a certain fixed limit, yet the weight on drivers must be correct. It may be necessary to cut down a little weight at one point, or add a little at another, lengthen or shorten the tubes in the boiler or decrease or increase the diameter of the shell. The fire-box may be so wide that it will not go in between the frames or the diameter of the drivers may be such that it is impracticable to place the fire-box above them. The only remaining expedient is to allow the fire-box to extend backward from the drivers and support its weight on a trailing truck. This is in brief the reason for the use of the trailing truck, and why the Prairie type (2-6-2) is used instead of the ten-wheeler (4-6-0), or the Atlantic type (4-4-2) instead of the eight-wheeler (4-4-0).

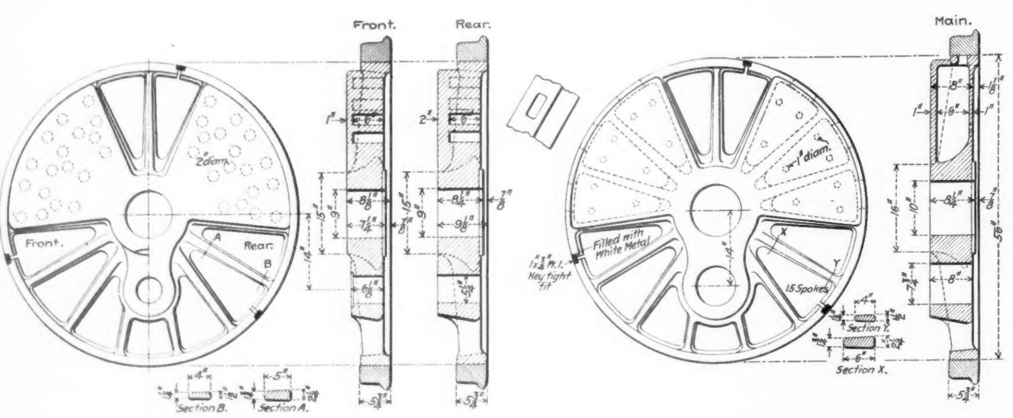
Fifteen or twenty years ago the standard passenger engine was the eight-wheel or 4-4-0 type, weighing about 85,000 lbs., with 60,000 lbs. on the drivers, and having cylinders 17 in. x 24 in.—the total heating surface being about 1,200 sq. ft. The fire-box was narrow, being limited in width by the frames, and in length by the distance between the axles of the rear and forward drivers. The length of the grate did not exceed about 6 ft., and the width was about 3 ft., giving a grate area of about 18 sq. ft. This type of engine was satisfactory as long as train speeds were relatively low, and the weight hauled was not excessive. Naturally the first change in design to meet the demands of the service was to increase the size of the boiler, the weight on drivers, and hence the cylinder power, but retain the same wheel arrangement. As the boiler increased, however, it became necessary to increase the grate surface in order that efficient combustion could be maintained, and this was done by placing the fire-box on the engine frames, thus gaining their added width, and by spacing the driving axles farther apart. An example of one of the first attempts to increase the power of the eight-wheel engine is the old 800 class of the New York Central, designed by Wm. Buchanan, then Superintendent of Motive Power. This type of engine weighed about 126,150 lbs., with 81,400 lbs. on the drivers, the cylinders being 19 in. x 24 in. The heating surface of the boiler was 1,834 sq. ft., and the fire-box was about 8 ft. long x 3 ft. 5 in. wide. The increase in heating surface, aside from that gained by increasing the size of the fire-box, was obtained by lengthening the tubes from 11 ft. 6 in. (in the smaller engine) to 12 ft., and increasing the diameter of the boiler from 52 in. to 58 in. A further development of the eight-wheel engine is the well known 900 class of the New York Central, which was specially designed for handling the fast trains between New York and Chicago during the Columbian Exposition. The 900 class had 86-in. drivers instead of the 78-in. drivers of the 800 class. The cylinders were the same size as those of the 800 class, but the heating surface in the boiler was increased to 1,930 sq. ft., and the grate area was increased to 31 sq. ft. While the weight on drivers of the 900 class was about 3,000 lbs. more than the weight on drivers of the 800 class, the total weight of the 900 class engine was reduced by about 2,000 lbs. The 900 class did good work, but occasionally failed at the higher speeds by not having sufficient boiler capacity. As a result the well known Class I. Central Atlantic (4-4-2) type engines were designed and are used in hauling heavy 12 and 13 car trains, at sustained speeds of over 50 miles an hour. These engines weigh 176,000 lbs. with 95,000 lbs. on the drivers, cylinders 21 in. x 26 in., heating surface 3,505 sq. ft. and a grate area of 50.3 sq. ft. The drivers are 79 in. in diameter. The weight on drivers of the Atlantic type engine is only about 10,000 lbs. more than the weight on drivers of the 900 class, yet the total weight is about 52,000 lbs. more, and the heating surface and grate area of the boiler has been increased by about 70 per cent.



Fire-box of Northern Pacific 4-6-2 Locomotives.

Assuming that a 13 car train weighs about 500 tons and the train resistance at 50 miles an hour is 14½ lbs. per ton, on a straight and level track, the horse-power required to be developed at the drawbar behind the tender is 960. Assuming that losses in the mechanism of the engine and tender are 30 per cent. at that speed, and estimating that the development of one horse-power requires 26 lbs. of water per hour, then the total evaporation of the boiler under the above conditions must be at the rate of about 35,600 lbs. per hour. For economical operation the rate of evaporation should not exceed 10 lbs. of water per sq. ft. of heating surface per hour, and on this basis the boiler should contain about 3,560 sq. ft. of heating surface in order to do the work economically and at the same time have sufficient reserve power to make bursts of speed with lighter trains when necessary in order to keep on time. But the Central Atlantic boiler actually contains 3,505 sq. ft. of heating surface. It would be, indeed, a difficult problem in design to place a boiler of that size upon an eight-wheel engine without increasing the weight on drivers beyond the limits fixed by the condition of the permanent way. The Lehigh Valley has used an eight-wheel engine having 91,000 lbs. on drivers, 68-in. drivers, and a boiler with a total heating surface of 1,912 sq. ft., in which the grate area was 67.6 sq. ft. The fire-box was the Wooten type and extended over the drivers. With engines having over 3,000 sq. ft. of heating capacity and drivers 79 in. in diameter, such an arrangement would be impossible. The New York, New Haven & Hartford uses an eight-wheel engine in fast passenger service, having a boiler with 2,114 sq. ft. of heating surface and a grate area of 30.2 sq. ft., 73-in. drivers, and a total adhesive weight of 86,000 lbs. But in this engine the fire-box is small and is between the drivers.

In the above it has been attempted to trace the development of the Atlantic type engine, and to show the conditions that had to be met and the expedients which were used in meeting these conditions. In the same manner the development of the Pacific or 4-6-2 type can be shown to be the development of the ten-wheeler or 4-6-0 type, the Mikado or 2-8-2 type the development of the consolidation or 2-8-0 type, and the Prairie or 2-6-2 type the development of the ten-wheel or 4-6-0 type. From general appearance the Prairie (2-6-2) type would seem to be the development of the Mogul or 2-6-0 type. There is no good reason why such might not be the case, but all Prairie type locomotives so far built are being used in place of the ten-wheel engine. Both types have the same number of drivers, and hence the tractive force will be about the same. But the Prairie type has a single leading truck in place of the "pony" truck of the ten-wheeler, and a trailing wheel is placed behind the drivers and beneath the fire-box. The following table giving the average dimensions of three representative Prairie and ten-



Davis Counterbalance Used on St. Louis & San Francisco Ten-Wheelers.

wheel engines noted in the accompanying large table, is interesting in view of the above general statements:

Type.	Total wgt.	Wgt. on drivers.	Heating surface.	Grate area.
Prairie	189,000	136,000	3,125	50.8
Ten-wheel	173,000	133,600	2,758	32.7

It will be noted that the difference in weight on drivers between the two types in question is but 2,400 lbs., whereas the difference in total weights is 16,000 lbs.—the greater weight of the Prairie type being due to the larger and more powerful boiler. In the same manner the Pacific or 4-6-2 type, which is virtually a ten-wheeler with a trailing truck added, is larger and more powerful than either the Prairie or the ten-wheel types. Similar averages from the large table of the principal dimensions of the representative Pacific type engines show that the total weight, weight on drivers, heating surface, and grate area is 210,000 lbs., 138,000 lbs., 3,770 sq. ft., and 50.6 sq. ft. respectively. This type of engine is coming into use where the demands for power are greater than that which can well be supplied by an engine of the Prairie or ten-wheel type.

A notable example of the substitution of the Prairie type engine for the ten-wheeler is found on the Lake Shore. Several years ago the heavy and fast passenger service of the Lake Shore was handled by a ten-wheel engine weighing about 171,000 lbs., with 133,000 lbs. on the drivers; cylinders 20 in. x 28 in., drivers 80 in. in diameter, with a boiler having 2,917 sq. ft. of heating surface and 33.6 sq. ft. of grate area. These engines have given way to a 2-6-2 type locomotive weighing 174,500 lbs., with 130,000 lbs. on drivers, cylinders 20½ in. x 28 in., driving wheels 80 in. in diameter, and a boiler having 3,343 sq. ft. of heating surface, and 48.5 grate area. The weight on drivers by the new wheel arrangement has actually been decreased by about 3,000 lbs., with a corresponding decrease in the cylinder dimensions. The same size drivers has been retained but the heating surface in the boiler has been increased by over 400 sq. ft., and the grate area by about 15 sq. ft., making in all a more powerful and economical design. The Lehigh Valley has also taken out of service their heavy ten-wheelers which were designed to haul 400 tons at 30 miles per hour on the grade between Mauch Chunk and Glen Summit, a distance of 33 miles, with an average grade of 25.3 per mile. A Prairie type engine is now being used, having 3,670 sq. ft. of heating surface, as against 2,708 sq. ft. in the ten-wheelers, while at the same time the weight on drivers has not been greatly changed.

In passing, reference must be made to the use of the traction increaser which has been made practicable through the introduction of the trailing wheel. The idea of the traction increaser is almost as old as the locomotive, reference having been made to such a device on some of the early engines built by Mathias Baldwin in the 40's. None of these early devices were practicable, however, owing to difficulties in the way of applying them to the designs then in use, but, at the present time, a number of roads have found that the use of a device transferring additional weight to the driving wheels at starting, is both economical and efficient. The New York Central engines referred to above are fitted with a traction increaser which throws about 10,000 lbs. from the rear trucks to the driving wheels, and in this manner increases the adhesive weight from 95,000 lbs. to 105,000 lbs. Another road which has adopted the traction increaser is the Atchison, Topeka & Santa Fe, where they are used in both passenger and freight service. It is claimed that the traction increaser decreases the slipping of the drivers, thereby reducing the cost of repairs to the tires without resulting in any increase in maintenance charges. Some difficulty has been experienced with the leather packing in the air cylinders operating the device, but the use of metallic packing has done away with this objection. The possibilities of the traction increaser as an economical feature in modern locomotive construction should not be underestimated or overlooked.

The largest and most powerful locomotive in the world was built during 1902 for the Atchison, Topeka & Santa Fe. The wheel arrangement is the 2-10-0, and the total weight is 267,800 lbs., with 237,800 lbs. on the drivers. The boiler of this engine is by far the largest ever built, containing nearly 5,400 sq. ft. of heating surface. The tractive power is something over 63,000 lbs. Recently the same road has received from the Baldwin Works a 2-8-2 locomotive weighing 260,000 lbs., with 200,000 lbs. on the drivers. The boiler is identical to that of the 2-10-0 above noted, and the engine is fitted with a traction increaser which transfers part of the weight on the trucks to the drivers. The traction increaser is operated by the position of the reverse lever so that the weight on drivers returns to normal as soon as the engine is "hooked up."

Other heavy freight engines have been built for a number of roads but, in passing, it is desired to call attention to the new consolidation of 2-8-0 type locomotives recently built by the American Locomotive Co. for the New York Central. One of these engines is illustrated herewith. It weighs 284,500 lbs. in working order, 198,500 lbs. being available for adhesion. The cylinders are tandem compound and are 16 in. and 30 in. x 30 in. The boiler has a total of 4,116.5 sq. ft. of heating surface, and the grate area is 58 sq. ft. The weight on drivers is about the same as that of the 2-8-2 locomotive of the Atchison, above described, but the heating surface is about 1,200 sq. ft. less than that of the Atchison engine. However, the New York Central engine has compound cylinders, whereas, the Atchison engine has simple cylinders, and this feature of the design makes up, in part, for the lesser amount of heating surface, inasmuch as the maximum power of a locomotive depends on the ability of the boiler to furnish steam and upon the rate at which it is used by the cylinders per unit of work developed. Two engines, therefore, similar in every respect except that one is compound and the other simple, will have steaming capacities proportional to the cylinder efficiencies.

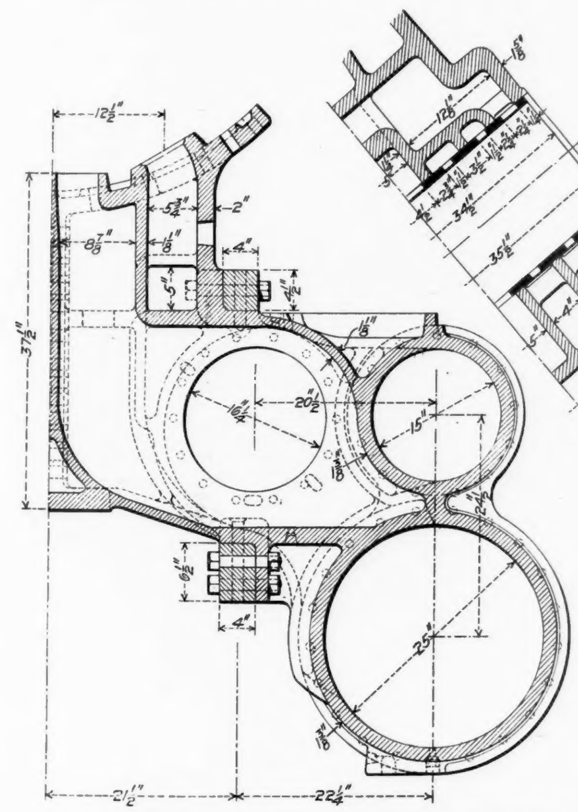
A good example of a lighter consolidation engine built during the past year is the one shown herewith for the Hannibal & St. Joseph, which weighs about 207,900 lbs., with 181,000 lbs. on the drivers, cylinders 22 in. x 28 in., heating surface 3,826 sq. ft., and the grate area 54 sq. ft. The cylinders have piston valves, specially designed to give a small clearance volume.

Another freight engine that attracted much attention at the time it was built was a 2-8-2 locomotive for the Bismarck, Washburn & Great Falls, designed for burning lignite. The cylinders are Vauclain compound, 14 in. and 24 in. x 26 in., and the total heating surface in the boiler is 2,322 sq. ft. The engine was built to haul 890 tons over a one per cent. grade, having a 9 deg. curve, and in a test it succeeded in hauling 940 tons, the maximum speed on level track being 18 miles an hour, while the lowest speed at the summit of the above-mentioned grade was two miles an hour. No difficulty was experienced in maintaining the steam pressure.

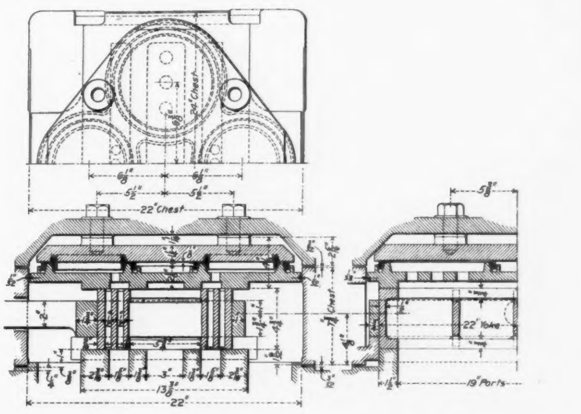
The largest passenger locomotive built during the year, and in fact ever built, was recently delivered to the Chicago & Alton by the Baldwin Locomotive Works. This engine is the 4-6-2 or Pacific type, and weighs 219,000 lbs., with 142,000 lbs. on the drivers, cylinders 22 in. x 28 in., drivers 73 in. in diameter, and the total heating surface in the boiler 4,078 sq. ft., and the grate area 54 sq. ft. The boiler is designed to carry 220 lbs. pressure, and contains 330 20-ft. tubes 2¼ in. in diameter. These engines are designed for handling the prospective heavy passenger traffic which will originate at Chicago during the St. Louis Fair, and this type of engine has been adopted after experimenting with a number of engines borrowed from other roads. The tender has a capacity of 8,400 gal., and is the largest ever built.

Another engine of this type which approaches the size of the Chicago & Alton engine has recently been delivered to the Northern Pacific by the American Locomotive Co. One of these engines is illustrated herewith. Twenty locomotives of this type were delivered to the Northern Pacific, part having balanced slide valves and part having piston valves, as shown by the accompanying illustrations. It is the purpose of the road to make experiments with the two types of valves to determine which gives the better results. These new engines weigh 202,000 lbs., with 134,000 lbs. on drivers, cylinders 22 in. x 26 in., drivers 69 in. in diameter, with a total heating surface in the boiler of 3,462 sq. ft., and a grate area of 47.2 sq. ft. The length of the tubes in the boiler is 18 ft. 6 in. These engines are designed for hauling the "North Coast Limited," and the "Pacific Express." The "North Coast Limited" consists of eight or nine cars weighing from 419 to 474 tons exclusive of the engine. The "Pacific Express" is made up of from nine to 13 cars, weighing from 430 to 640 tons. The grades over which these trains are hauled vary from 5 per cent. to 2.2 per cent., and the mountain grades vary from 13 to 27 miles in length. The "North Coast Limited" is scheduled at 35.7 miles an hour, including stops, on the division of the .5 per cent. ruling grade. This division is also subjected to severe winds during the greater portion of the year, and also has a steady rise of 1,400 ft. in 115 miles. One of the best performances made by these engines hauling the "North Coast Limited" on this division was an average speed of 43.9 miles, including three stops, with a strong quartering wind blowing. On the mountain grades the schedule speed is 20.4 miles an hour for the "North Coast Limited," and 18.8 miles an hour for the "Pacific Express." A helper is used on the mountain grades. This type of engine was designed "in order to obtain the heating surface and boiler capacity sufficient to supply the large cylinders of these engines at the schedule speed of the trains."

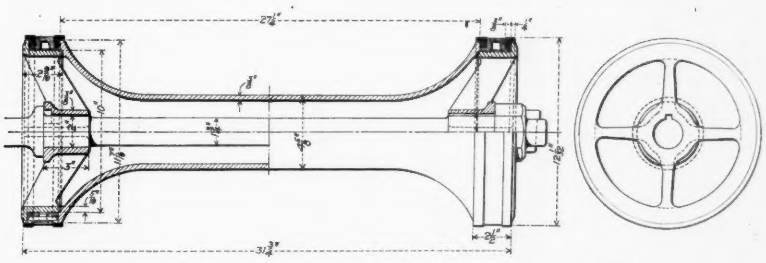
During the past year the Pennsylvania has had built a number of E-2-a Atlantic type locomotives for fast passenger service. The engines are simple and have piston valves, and the fire-box is Belpaire. One of these engines is illustrated herewith. The total weight in working order is 176,000 lbs., and the weight on drivers is 109,000 lbs. The cylinders are 20½ in. x 26 in., but the total heating surface is only 2,640 sq. ft., with 166 sq. ft. in the fire-box. The boiler contains 315 2-in. tubes, and the grate area is 55.5 sq. ft. It is interesting to compare this locomotive with the Atlantic type engines used on the New York Central. The two engines have practically the same total weight, size of cylinders and weight on drivers, but the heating surface of the Penn-



Section Through Vauclain Cylinders of Erie 4-4-2 Locomotive.



Balanced Slide Valve for Northern Pacific 4-6-2 Locomotives.



Piston Valve for Northern Pacific 4-6-2 Locomotives.

sylvania engine is about 900 ft. less than that of the New York Central engine, while the grate area is about 10 per cent. greater than that of the Central Atlantic engine. The boiler of the New York Central engine contains 396 tubes 16 ft. long, while the tubes in the Pennsylvania engine are only 15 ft. 1 in. long. Basing the power developed on the size of cylinders and weight on drivers, it would appear that the cylinder power of the two engines is about the same, although the Pennsylvania engine has the smaller boiler. A more liberal spacing of the tubes in the Pennsylvania engine and their shorter length will no doubt make up, in part, for the lesser number of square feet of heating surface. This is an interesting point, and it has been frequently questioned if the zeal of the American designer to produce a boiler with as much heating surface as possible has not led him into serious error in regard to the proportions of the several parts. In other words, it is reasonable to expect ers. The Vauclain valve is used which does away with the two sets of valves used in the De Glehn engine. The Atchison is also having built some Atlantic type locomotives having similar arrangement of cylinders. The Atchison engines will weigh 187,000 lbs., with 90,000 lbs. on the drivers, and the cylinders will be 15 in. and 25 in. x 26 in. The diameter of the drivers will be 73 in., and the total heating surface in the boiler will be 3,029 sq. ft. These two engines mark, no doubt, the beginning of a more general use of the balanced arrangement in this country. The arguments for the four-cylinder balanced compound are many. In addition to relieving the track from the severe strains produced by the vertical components of the unbalanced forces in the usual arrangement of cylinders, the four-cylinder balanced compound divides the stresses in the locomotive among a greater number of parts and hence diminishes the liability of failure in service. This type of engine is the standard piston and slide valve. But in passing, mention must be made of the use of superheated steam. The Canadian Pacific has been experimenting with a locomotive fitted with the Schmidt superheater, and it is reported that they have done well in service. For some years superheated steam has been used on German roads, and the results show that the economy of the superheated steam locomotive is equal to that of the compound.

Tentative designs have also been made of a boiler having water tubes in the fire-box and by such an arrangement over 6,000 sq. ft. of heating surface has been obtained. The London & South-Western has had in use for some time about 100 engines fitted with the so-called Drummond boiler which has a double shell with water tubes crossing from one side to another and exposed to the hot gases. It is reported that these boilers are more economical than the ordinary type. If a boiler with water tubes proves successful after years of hard service,

PRINCIPAL DIMENSIONS OF TYPICAL AMERICAN LOCOMOTIVES.
(Arranged in classes according to total weight.)

Road and Builder.	Total weight, lbs.	Weight on drivers, lbs.	Cylinders, in.	Diam. of drivers, in.	Htg. surface, sq. ft. In tubes.	In fire-box.	Total.	Grate area, sq. ft.	Working Pressure, lbs.	Length of tubes, ft. & in.	Htg. surface / Grate area.	Wt. on drivers / Htg. surface.	Reference in *Railroad Gazette*.
Atlantic (4-4-2) *Type.*													
Central Railroad of New Jersey—Amer. Locomotive Co.	190,600	99,400	20½x26	85	2,793	174	2,967	82.0*	210	16— 6¼	36.2	33.6	Jan. 3, 1902.
Atchison, Topeka & Santa Fe†—Baldwin	187,000	90,000	15 & 25x26	73	2,839	190	3,029	49.4	220	18— 0	61.3	29.7	....
Cleveland, Cincinnati, Chicago & St. Louis—Am. Loco. Co.	186,000	100,000	20½x26	78	3,165	175	3,340	51.6	200	16— 0⅛	64.9	30.0	Oct. 31, 1902.
Erie—Baldwin	180,000	88,000	15 & 25x28	76	2,639	172	2,811	46.7	200	16— 6	60.2	31.3	June 19, 1903.
Pennsylvania—American Locomotive Co.	176,600	109,000	20½x26	80	2,474	166	2,640	55.5	205	15— 1	47.6	41.3	June 19, 1903.
New York Central—American Locomotive Co.	176,000	95,000	21x26	79	3,298	207	3,505	50.3	200	16— 0	69.6	27.1	Feb. 1, 1901.
Chicago, Milwaukee & St. Paul—Baldwin	170,000	90,000	15 & 25x28	84	3,008	190	3,198	40.0	200	16— 6	79.9	28.1	Sept. 20, 1901.
Chicago & North Western—American Locomotive Co.	158,000	91,000	20x26	80	2,817	199	3,016	46.3	200	16— 0	64.9	30.2	Aug. 3, 1900.
Baltimore & Ohio—Baldwin	149,600	83,400	15 & 25x28	78	2,513	150	2,663	42.5	200	16— 1	62.6	31.4	Jan. 11, 1901.
Pacific (4-6-2) *Type.*													
Chicago & Alton—Baldwin	219,000	142,000	22x28	73	3,848	230	4,078	54.0	220	20— 0	75.5	34.8	Nov. 7, 1902.
Northern Pacific—American Locomotive Co.	202,000	134,000	22x26	69	3,264	198	3,462	47.2	200	18— 6	73.3	38.7	June 19, 1903.
Chesapeake & Ohio—American Locomotive Co.	187,000	131,000	22x28	72	3,328	205	3,533	47.0	200	19— 6	75.2	37.1	Aug. 1, 1902.
Missouri Pacific—American Locomotive Co.	173,000	120,000	20x26	69	2,779	174	2,953	42.4	200	18— 6½	69.5	40.6	Aug. 1, 1902.
Prairie (2-6-2) *Type.*													
Lehigh Valley—Baldwin	....	....	22x26	76½	3,457	213	3,670	...*	...	20— 0	...	...	May 29, 1903.
Illinois Central—Rogers	203,000	144,000	20x28	75	3,333	201	3,534	51.0	200	19— 0	69.3	40.7	June 20, 1902.
Atchison, Topeka & Santa Fe—Baldwin	190,000	135,000	17 & 28x28	79	3,543	195	3,738	53.5	200	19— 0	69.9	36.1	Nov. 22, 1901.
Lake Shore & Michigan Southern—American Locomotive Co.	174,500	130,000	20½x28	80	3,169	174	3,343	48.5	200	19— 0	69.0	38.9	Mar. 29, 1901.
Chicago, Burlington & Quincy—Aurora shops	140,000	96,000	19x24	64	1,937	139	2,076	42.0	190	16— 1	49.4	45.8	May 30, 1900.
Ten-Wheel (4-6-0) *Type.*													
St. Louis & San Francisco—Baldwin	189,210	141,760	15½ & 26x28	63	2,739	141	2,880	43.6	200	15— 5½	66.2	49.2	June 19, 1903.
Lehigh Valley—Baldwin	182,000	135,000	17 & 28x26	72	2,537	172	2,708	71.3*	200	15— 0	38.0	49.8	Dec. 28, 1900.
Delaware, Lackawanna & Western—Amer. Locomotive Co.	179,000	137,000	20x28	69⅜	2,520	180	2,700	84.2*	210	13—10¼	32.1	50.7	June 22, 1900.
Plant System†—Baldwin	176,510	127,010	15 & 25x26	73	2,665	128	2,793	27.3	200	15— 2	102.3	45.5	Feb. 28, 1902.
Cleveland, Cincinnati, Chicago & St. Louis—Baldwin	174,200	134,000	20x28	78	2,658	200	2,858	34.3	200	14— 9¾	83.5	46.8	May 24, 1901.
Northern Pacific—American Locomotive Co.	173,000	134,000	20x28	69	2,325	174	2,499	30.2	200	13— 0	82.7	53.5	Mar. 22, 1901.
Lake Shore & Michigan Southern—Amer. Locomotive Co.	171,600	133,000	20x28	80	2,694	223	2,917	33.6	210	15— 0¼	87.4	45.6	Nov. 10, 1899.
Atchison, Topeka & Santa Fe—Topeka shops	169,000	123,000	14 & 24x28	77	1,758	165	1,923	26.5	200	14— 2	72.5	64.0	Jan. 12, 1900.
Central Railroad of New Jersey—American Locomotive Co.	161,000	120,000	19x26	69	2,031	156	2,187	67.7*	210	13—10⅛	32.3	54.9	July 4, 1902.
Mogul (2-6-0) *Type.*													
Southern Pacific—Baldwin	176,640	153,880	15½ & 26x28	63	2,163	177	2,340	oil	200	13— 0	...	65.7	Nov. 29, 1901.
Pennsylvania—Baldwin	162,500	140,300	20x28	62	2,315	154	2,469	48.9	205	12— 1¾	50.4	56.7	Nov. 1, 1901.
Delaware, Lackawanna & Western—Amer. Locomotive Co.	161,000	140,000	20½x26*	63	2,176	166	2,342	53.4	200	13— 6	43.8	59.8	June 19, 1903.
New York Central—American Locomotive Co.	155,200	135,500	20x28	57	2,322	186	2,508	30.3	190	12— 2½	82.8	54.0	Mar. 30, 1900.
New York, Ontario & Western—American Locomotive Co.	151,000	134,000	19½x28	69	1,960	160	2,120	80.0*	200	11— 4	26.5	63.2	June 26, 1901.
Consolidation (2-8-0) *Type.*													
Bessemer & Lake Erie—American Locomotive Co.	250,000	225,200	24x32	54	3,564	241	3,805	36.8	220	15— 1	104.2	59.1	June 29, 1900.
New York Central—American Locomotive Co.	224,500	198,500	16 & 30x30	51	3,889	228	4,117	58.0	210	14— 9	70.9	48.2	June 19, 1903.
Hannibal & St. Joseph—American Locomotive Co.	207,900	181,000	22x28	57	3,606	222	3,828	54.2	210	15— 0	70.6	49.8	June 19, 1903.
Southern Pacific—American Locomotive Co.	200,000	176,000	23 & 35x34	57	3,391	208	3,599	54.5	220	14— 9	66.0	48.9	Apr. 5, 1901.
New York, Ontario & Western—American Locomotive Co.	198,130	170,200	21x32	55	3,095	194	3,289	87.4*	200	14— 9	37.6	51.7	Mar. 23, 1900.
Northern Pacific—American Locomotive Co.	198,000	175,000	15 & 28x34	63	2,815	182	2,997	52.3	225	16— 0	57.4	58.4	Aug. 30, 1901.
New York Central—American Locomotive Co.	190,000	164,000	23 & 35x32	63	3,041	176	3,217	50.3	210	14— 4	64.0	51.0	Mar. 1, 1901.
Baltimore & Ohio—American Locomotive Co.	186,000	162,000	21x30	57	3,298	178	3,476	50.3	190	16— 0	69.2	46.6	Dec. 5, 1902.
Rio Grande Western—American Locomotive Co.	184,400	167,450	23½ & 36x30	56	2,667	206	2,873	34.7	200	14— 2⅞	82.8	58.4	June 28, 1901.
Lake Shore & Michigan Southern—Amer. Locomotive Co.	168,000	149,000	21x30	62	2,452	230	2,682	33.5	200	15— 0¼	80.0	55.6	Mar. 2, 1900.
Decapod (2-10-0) *Type.*													
Atchison, Topeka & Santa Fe—Baldwin	267,800	237,800	19 & 32x32	57	5,156	234	5,390	58.5	225	19— 0	92.1	44.1	May 30, 1902.
Atchison, Topeka & Santa Fe—Amer. Locomotive Co.	259,800	232,000	17½ & 30x34	57	4,477	205	4,682	59.5	225	18— 6	78.6	49.5	Jan. 31, 1902.
Minneapolis, St. Paul & Sault Ste. Marie—Baldwin	210,000	185,000	17 & 28x32	55	2,799	201	3,000	37.5	215	15— 7	80.0	61.6	....
Mikado (2-8-2) *Type.*													
Atchison, Topeka & Santa Fe—Baldwin	260,000	200,000	18 & 30x32	57	5,156	210	5,366	58.5	225	19— 0	91.7	37.2	Apr. 3, 1903.
Mexican Central—American Locomotive Co.	193,450	145,200	21x26	49	....	...	....	...	...	12—1 11/16	...	...	Jan. 24, 1902.
B., W. & Great Falls—Baldwin	166,900	128,000	14 & 24x26	50	2,322	174	2,496	56.0	200	16— 6	44.6	51.2	Jan. 10, 1902.

* Anthracite fuel. † Four-cylinder balanced compound.

that the efficiency of a square foot of heating surface in the Pennsylvania engine will be greater than that in the New York Central locomotive. On the other hand, the New York Central locomotive is officially reported to have hauled a load of 731 tons, including weight of engine, a distance of 118.2 miles in 127 minutes, or at the rate of 55.8 miles an hour. Simple calculations show that the evaporation of the boiler must have been close to 15 lbs. of water per square foot of heating surface per hour, a value close to the maximum capacity of any boiler.

Another passenger engine that brought out much comment at the time it was built was the ten-wheel four-cylinder balanced compound for the Plant System by the Baldwin Locomotive Works. The cylinders are the Vauclain compound arranged horizontally, and approximates the De Glehn compounds which have gained world-wide reputation on the Northern of France. The two high-pressure cylinders are inside the frames and are connected with the cranked axles of the forward drivers, while the low-pressure cylinders are on the outside of the frames and connect in the usual way to the forward driv- for fast passenger service on the Northern of France. The latest De Glehn engines in use on the Northern of France are the Atlantic type, having cylinders 13.38 in. and 22.05 in. x 25.2 in. The weight on drivers is 71,200 lbs., and the total weight is about 142,000 lbs. The total heating surface is 2,274 sq. ft., with 166.8 sq. ft. in the fire-box. The grate has a decided slope, and its area is 29.6 sq. ft.—rather small compared with American practice. It is officially reported that between Paris and Calais trains of from 250 to 300 tons are hauled up long grades at speeds never less than 50 to 53 miles an hour. On one occasion with a load of 10 coaches or 287 tons, and with a heavy side wind blowing, a run of 102 miles was made in 105 minutes. The De Glehn engines have independent valves for each cylinder. The four-cylinder balanced compounds built by the Baldwin Works have but one valve for each side of the engine.

It has by no means been attempted to note in the above brief discussion all of the features of the modern locomotive. The arguments for and against the use of the compound locomotive would in itself fill many pages, while much could be said about the relative merits of the it will open the way to locomotives of greater power than that of any so far built.

Predictions are usually dangerous, but it will no doubt be safe to say that the future development of the locomotive will be towards a refinement in the design of the several elements so that greater power can be got from a given weight than is now possible. The developments of the past have been chiefly in an increase in size, but now it appears that the limit in size has been about reached as determined by road clearances and other controlling elements not within the power of the locomotive designer to change.

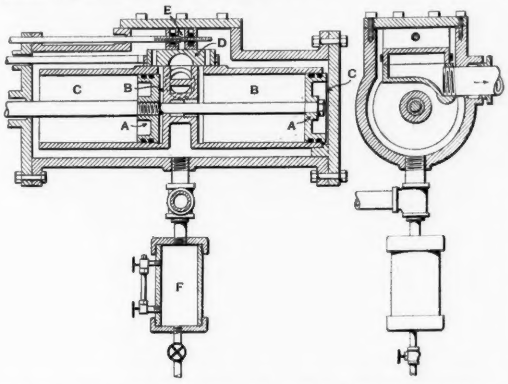
The Italian company owning the Valtellina Railroad (along the east shore of Lake Como with a branch eastward), which has been worked by electricity for some time past, has ordered from Ganz & Co. three additional electric locomotives, to have a tractive capacity of 7,700 to 11,550 lbs. at speeds of 40 miles an hour, and of 13,200 to 22,000 lbs. at 20 miles an hour. They are to weigh 61½ tons, with four axles, all motors.

Performance of an Engine Designed for Maximum Jacketing Effects.

BY W. F. M. GOSS.

This engine was designed by Messrs. L. and W. A. Hicks, of Cincinnati, Ohio. The design has been made to secure an arrangement by means of which the cylinder walls can at all times be maintained at a temperature closely approaching that of the initial steam. The design, so far as the writer recalls, is quite new, and the fact that a small engine embodying this principle has been run with economy under 10 expansions, and with a steam consumption of less than 24 lbs. per horse-power per hour makes the design of sufficient interest to merit attention.

The Engine.—The novel features are well shown by the cross section. The design involves two pistons (A) of the same diameter, placed upon a common piston rod, and hence having identically the same motion. These pistons work in cylinders which are separated from each other by an interior partition or head, the effective working volume of the cylinders being the space between this head and each of the pistons, that is, the space B B. Those portions of the cylinders which are outside of the



Section Through Cylinders of Hicks Jacketed Engine.

pistons, that is, the portions C C, as well as the exterior surfaces of the cylinders themselves, are exposed to the free action of live steam under whatever initial pressure it may be admitted to the engine. The pressure upon the outside of one piston, therefore, neutralizes the pressure upon the outside of the other piston, action in the engine being had by the admission and discharge of steam within the spaces B. In this manner, each cylinder with its piston constitutes a single-acting engine, while the combined action of both pistons reproduces the cycle of the ordinary double-acting engine. Steam is distributed by means of the valve D and the cut-off valves E, the arrangement being such as to give a good distribution of steam and a wide range of cut-off.

The effect of the design described is somewhat comparable with that obtained by use of the more common forms of the steam jacket, except that in the Hicks design, the interior walls of the cylinder are washed by steam at initial pressure, and thus thoroughly heated before the advancing piston, while in the usual form of jacket only the exterior walls of the cylinder are immersed in high pressure steam. It is clear that the design provides for a much more complete system of heating the walls of the cylinder than is supplied by the usual forms of jacket, and it is fair to expect that whatever advantage is derived from the use of the ordinary forms of jacket will be exceeded in effect by the arrangement prevailing in the Hicks' engine.

In usual forms of jackets, heat is transmitted from the jacket to the metal of the cylinder, and, as a consequence, steam is condensed within the jacket, and a similar action is assumed to take place within the Hicks engine, the condensation in this case being allowed to pass to the drip chamber F from which it may be drawn by a suitable trap.

The parts thus far described were constructed especially for the experiments herein set forth and were adapted to meet the requirements of a second-hand horizontal engine of rather antiquated design. In this manner, it happened that the moving parts of the engine were light and were not well balanced so that as a whole, the engine was not without defects, but all parts in contact with steam were designed and constructed entirely to the satisfaction of the Messrs. Hicks.

The dimensions of the engine and the constants employed in working up experimental data were as follows:

Diameter of cylinder, in.	6.125
Diameter of piston rod, in.	1.000
Stroke of piston, in.	10.
Displacement of each piston, cu. in.	286.8
Horse-power for one revolution and one pound mean effective pressure	.000724
Clearance in head-end, per cent	4.8
Clearance in crank-end, per cent	4.2

The Tests.—The machine was delivered to the Engineering Laboratory, Purdue University, for test. In preparation for the test, the exhaust was piped to a small Wheeler condenser and a friction brake was fitted to the fly-wheel. It was connected for steam by a well drained system of piping, and a throttling calorimeter was attached to the valve-box. Two indicators were used upon the cylinder, a registering counter gave the revolutions, and the same care was employed in securing data that would have been exercised in testing any engine however large. Four tests were run under the conditions and with the results stated below.

RESULTS FROM TESTS OF HICKS ENGINES.

(1) Number of test	1	2	3	4
(2) Cut-off, per cent. of stroke	5.5	9.9	23.4	34.
(3) Steam pressure, pounds by gage	131.	131.4	132.	133.
(4) Average r. p. m.	89.4	90.8	92.6	90.4
(5) Duration of test, minutes	60.	60.	60.	60.
(6) Condensed steam from cylinders	59.36	98.25	224.0	297.8
(7) Total heat in 1 lb. of dry steam at aver. press. of test	1190.5	1190.6	1190.7	1190.9
(8) Heat in one pound of water at temperature of exhaust.	180.	180.	180.	180.
(9) B. T. U. absorbed by engine for each pound of steam delivered from cylinder	1010.5	1010.6	1010.7	1010.9
(10) Condensed steam from trap	12.25	18.43	18.30	12.20
(11) Total heat in each pound of steam used by trap	1190.5	1190.6	1190.7	1190.9
(12) Heat in one pound of water at temperature of trap.	327.5	327.6	328.0	328.5
(13) B. T. U. absorbed by engine for each pound of steam condensed in trap	863.0	863.0	862.7	862.4
(14) Weight of condensed steam from trap reduced to the same basis as that delivered from cylinder—Item 13 ÷ Item 9 × Item 10	10.46	15.74	15.62	16.30
(15) Total equivalent wgt. of steam delivered from cylinders	69.82	113.99	239.62	308.1
(16) Average M. E. P.	22.48	35.80	60.65	77.73
(17) Horse-power of engine	2.91	4.71	8.13	10.17
(18) B. T. U. per horse-power per minute	403.	407.	484.	510.
(19) Pounds of steam per I. H. P. per hour	23.99	24.20	29.47	30.30

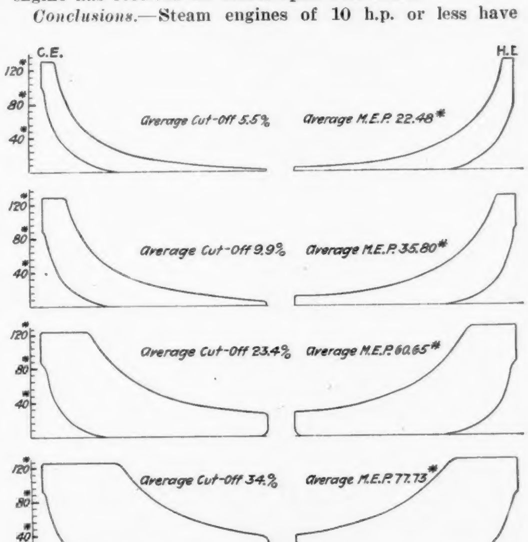
Typical indicator cards secured during the tests are presented herewith.

It should be noted that the above statement of performance is based upon the actual amount of steam passed by the engine. It includes the radiation losses from the trap F, the dimensions of which were in the experimental engine almost equal the dimensions of the cylinder. This, of course, was abnormal and the effect was to increase steam consumption.

Throughout the tests an open drain was maintained in the steam supply pipe near the engine, in view of which fact the steam supplied the engine was assumed to be dry. As this was called in question, however, a throttling calorimeter was attached to the valve box during the last two tests, the results from which show the quality of the steam to be in both cases, .988. The presence of steam so nearly dry as this in the valve box, at which point it must have been somewhat influenced by the cooling action of the cylinders, confirms the reasonableness of the original assumption, and, consequently, no credit has been allowed the engine for moisture in the steam supply.

Elaborate tests were made to determine the leakage of the engine, the results of which gave 1.2 of a pound as the amount leaking past the head-end, and 2.74 as the amount leaking past the crank-end per hour. Not only are these amounts small in themselves, but some work is obtained from steam leaking by the pistons, and for this reason, in making up the preceding figures, the engine has received no credit upon this score.

Conclusions.—Steam engines of 10 h.p. or less have



Typical Indicator Diagrams from Hicks Engine.

rarely required less than 30 lbs. of steam per indicated horse-power, whereas the Hicks engine, notwithstanding its small size, hardly exceeds this limit for a wide range of power, and under most favorable conditions, delivers an indicated horse-power on a consumption of 24 lbs.

Again, whereas in the high pressure single-expansion engine of the ordinary type, maximum performance is required to accompany a cut-off of approximately a quarter stroke, the maximum performance of the Hicks engine attends a cut-off as short as 5.5 per cent. of the stroke, thus demonstrating that the provisions of this design for keeping the walls of the cylinder heated permit short cut-offs without the incidental loss which in engines of the ordinary type attends very short cut-offs.

The thoroughness with which the walls are heated is disclosed by an entropy-temperature analysis of the indicator diagrams which shows that as the cut-off is diminished, the percentage of the steam which is initially condensed is also diminished. A condition which is the reverse of that which is found in unjacketed engines. As will be expected, also, the amount of heat restored during expansion is proportionately large.

It would seem that the Hicks engine presents interesting conditions for the student of thermodynamics as well as a field of some promise for those interested in the more practical problems of steam engine construction.

The writer acknowledges the assistance of Mr. Louis E. Endsley, B. M. E., Purdue University, '01, M. E., Purdue University, '03, under whose immediate direction the work of testing proceeded.

Employer and Employee.

We have heard a good deal of late of the American Navy. It was founded by Paul Jones. Paul Jones's character and achievements entitle him to a conspicuous place among the great men of the American Revolution. His fame, in the broad sense of enduring interest, ranks with that of Washington, Franklin, Jefferson, Hamilton, Adams and Robert Morris; and in his own particular province he stands absolutely alone. To the student of American history, mention of our Revolutionary Navy instantly suggests the name of Paul Jones, and no other.

The Continental Congress met in its second session May 10, 1775. On June 14 a provisional Marine or Naval Committee was appointed "to consider and report with respect to organization of a naval force." At first this committee consisted of Robert Morris, chairman; Philip Livingston, Benjamin Harrison, John Hancock, Joseph Hewes and Nicolas Van Dyke, members. At a session held June 24, 1775, this committee, on motion of Mr. Hewes, authorized the chairman "to invite John Paul Jones, Esquire, gent., of Virginia, Master Mariner, to lay before the committee such information and advice as may seem to him useful in assisting the said committee to discharge its labors."

Reporting in person to the committee, a list of inquiries in writing was handed to him, embracing two general subjects: First, "The proper qualifications of naval officers," and second, "The kind or kinds of vessels most desirable for the service of the United Colonies; keeping in view the limited resources of the Congress." In reply Jones laid before the committee two documents in writing; the one on Personnel under date of September 14, and the one Material dated Oct. 3, 1775. On the subject of Personnel Jones addressed the committee in the form of a letter to Joseph Hewes, which may be found on page 32 of the "Life of John Paul Jones," by Augustus C. Buell, and which will repay careful reading by every officer in charge of, or employer of, labor. The author feels that, as a whole, this letter of Paul Jones to the Marine Committee of the Continental Congress in 1775, embodies the logic and philosophy of naval organization and the elements of sea power to-day quite as fundamentally as it did then, or as they ever can be embodied under any conditions conceivable in the future.

The letter was read by George Washington, to whom Mr. Hewes submitted it before handing it to the committee. Mr. Hewes records Washington as saying after he had read it: "Mr. Jones is clearly not only a Master Mariner, within the scope of the art of navigation, but he also holds a strong and profound sense of the political and military weight of command on the sea. His powers of usefulness are great and must be kept constantly in view."

We print some extracts from this letter, feeling that they apply quite as clearly to the command of a railroad as they do to the command of a ship. The italics are ours:

"As this is to be the foundation—or I may say the first keel-timber—of a new navy, which all patriots must hope shall become among the foremost in the world, it should be well begun in the selection of the first list of officers. . . . It is by no means enough that an officer of the navy should be a capable mariner. He must be that, of course, but also a great deal more. He should be as well a gentleman of liberal education, refined manners, punctilious courtesy, and the nicest sense of honor . . . in his relations to those under his command; he should be the soul of tact, patience, justice, firmness, and charity. No meritorious act of a subordinate should escape his attention or be left to pass without its reward, if even the reward be only one word of approval. Conversely, he should not be blind to a single fault in any subordinate though, at the same time, he should be quick and unfailing to distinguish error from malice, thoughtlessness from incompetency, and well-meant shortcoming from heedless or stupid blunder. As he should be universal and impartial in his rewards and his approvals of merit, so should he be judicial and unbending in his punishment or reproof of misconduct. In his intercourse with subordinates he should ever maintain the attitude of the Commander, but that need by no means prevent him from the amenities of cordiality or the cultivation of good cheer within proper limits. Every commanding officer should hold with his subordinates such relations as will make them constantly anxious to receive invitation to sit at his mess-table, and his bearing toward them should be such as to encourage them to express

their opinions to him with freedom and to ask his views without reserve.

"It is always for the best interests of the service that a cordial interchange of sentiments and civilities should subsist between superior and subordinate officers aboard ship. Therefore, it is the worst of policy in superiors to behave toward their subordinates with indiscriminate hauteur, as if the latter were a lower species. Men of liberal minds, themselves accustomed to command, can ill brook being thus set at naught by others who, from temporary authority, may claim a monopoly of power and sense for the time being. If such men experience rude, ungentle treatment from their superiors, it will create such heart-burnings and resentments as are no wise consonant with that cheerful ardor and ambitious spirit that ought ever to be characteristic of officers of all grades. In one word, every commander should keep constantly before him the great truth, that to be well obeyed he must be perfectly esteemed.

"But it is not alone with subordinate officers that a commander has to deal. Behind them, and the foundation of all, is the crew. To his men the commanding officer should be Prophet, Priest and King! His authority when off shore being necessarily absolute, the crew should be as one man impressed that the Captain, like the Sovereign, 'can do no wrong.' This is the most delicate of all the commanding officer's obligations. No rule can be set for meeting it. It must ever be a question of tact and perception of human nature on the spot and to suit the occasion. If an officer fails in this, he cannot make up for such a failure by severity, austerity, or cruelty. Use force and apply restraint or punishment as he may, he will always have a sullen crew and an unhappy ship. But force must be used sometimes for the ends of discipline. On such occasions the quality of the Commander will be most sorely tried. You and the other members of the Honorable Committee will, I am sure, pardon me for speaking with some feeling on this point. It is known to you and, I presume, to the other gentlemen, your colleagues, that, only a few years ago, I was called upon in a desperate emergency, and as a last resort to preserve the discipline requisite for the salvation of my ships and my fever-stricken crew, to put to death with my own hands a refractory and wholly incorrigible sailor. I stood jury trial for it and was honorably acquitted. My acquittal was due wholly to the impression made upon the minds of the jury by the testimony of my crew. . . . I do not reproach myself. But it is a case to illustrate the truth of what I have already said, namely, that the commander should always impress his crew with the belief that, whatever he does or may have to do, is right, and that, like the Sovereign, he 'can do no wrong.' When a commander has, by tact, patience, justice, and firmness, each exercised in its proper turn, produced such an impression upon those under his orders in a ship of war, he has only to await the appearance of his enemy's top-sails upon the horizon. He can never tell when that moment may come. But when it does come he may be sure of a victory over an equal or somewhat superior force, or honorable defeat by one greatly superior. Or, in rare cases, sometimes justifiable, he may challenge the devotions of his followers to sink with him alongside the more powerful foe, and all go down together with the unstricken flag of their country waving defiantly over them in their ocean sepulchre.

"No such achievements are possible to an unhappy ship with a sullen crew. . . .

"It may not be possible to always realize these ideas to the full; but they should form the standard, and selections ought to be made with a view to their closest approximation. . . .

"*True as may be the political principles for which we are now contending, they can never be practically applied or even admitted on board ship, out of port or off soundings. This may seem a hardship, but it is nevertheless the simplest of truths. Whilst the ships sent forth by the Congress may and must fight for the principles of human rights and republican freedom the ships themselves must be ruled and commanded at sea under a system of absolute despotism.* . . .

"You are called upon to found a new navy; to lay the foundations of a new power afloat that must some time, in the course of human events, become formidable enough to dispute even with England the mastery of the ocean. Neither you nor I may live to see such growth. But we are here at the planting of the tree, and may be some of us must, in the course of destiny, water its feeble and struggling roots with our blood. If so, let it be so! We cannot help it. We must do the best we can with what we have at hand."

The Orleans Dynamometer Car.*

By M. HUET, *Comptroleur de Traction, Orleans Ry.*

The Orleans Company has just put into service a dynamometer car of a new type. The car, the dynamometer apparatus and the transmission of motion to the registering apparatus were designed by the Orleans Company and built in their shops; while the registering and measuring apparatus was designed and built by Messrs. Amsler-Laffon & Son, of Schaffouse, in accordance with a specification made by the company.

*Translated from the *Revue Generale des Chemins de Fer*, by Lawford H. Fry.

General Arrangement.

The apparatus has been arranged to give directly, either by a reading of a scale, or by the measurement of an ordinate on the graphical record, all the information necessary for the study of the running conditions of the train under test. The apparatus shows at any moment:

1. Speed of the train.
2. Resistance of the train.
3. Total work of overcoming this resistance from the beginning of the test.

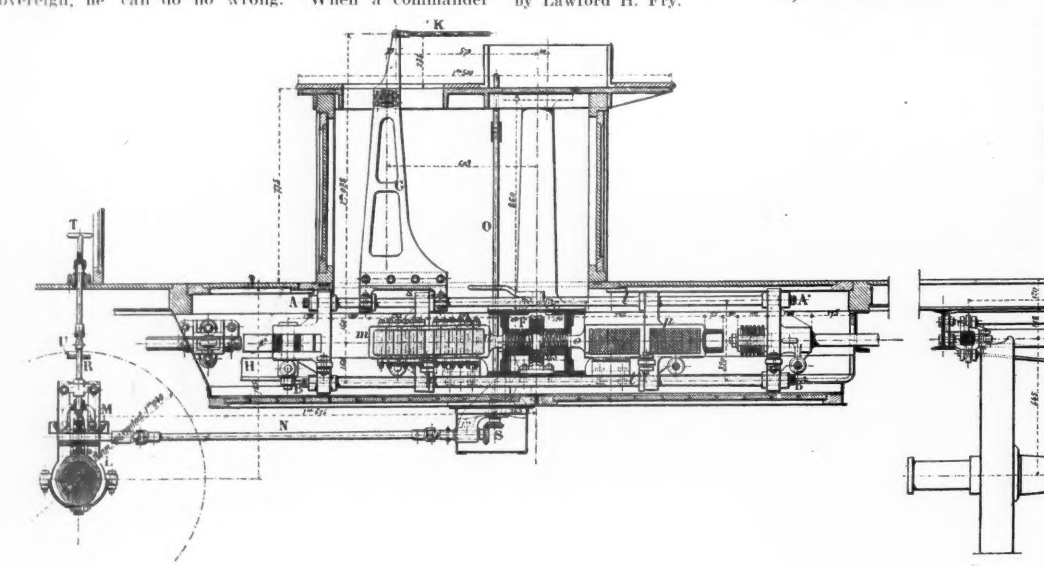
The apparatus has scale indicating instruments which give a direct reading for the speed and the total work, and registering instruments which trace on a strip of paper curves of which the ordinates are proportional, (1) to the force of tension or compression exerted on the wagon by the train, (2) to the speed, (3) to the work. The pull on the drawbar and the thrust on the buffers is measured by a set of dynamometer springs. The speed is measured and the paper for the curves of record is unrolled by gearing from one of the axles of the car. The transmission mechanism for measuring and registering the speed is the most original part of the apparatus. In order to measure the work done, a mechanical contrivance is used for forming the product of force into distance traveled, reducing the summation of the work to a question of counting the number of turns of a toothed wheel. The travel of the paper being controlled by the rotation of the axle, is not proportional to the time, and in order to be able to refer the information given by the curves to the time, or to the position of the train on the line, a chronometer is arranged to mark the time on the paper strip, while a pencil operated by an electro magnet enables the observer to mark the points of interest of the run.

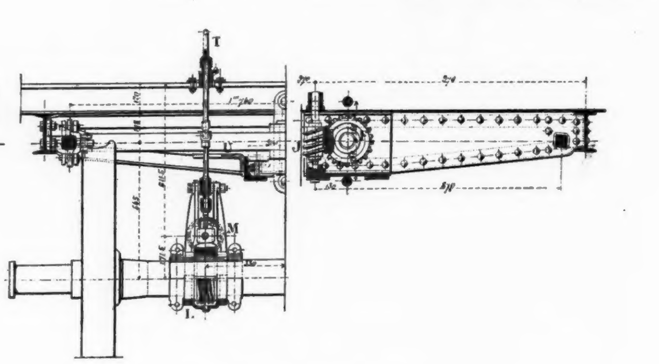
Arrangement of the Car.

The drawings show the general arrangement of the car which is built on the lines of the Orleans large six-wheeled carriages for through service. In these carriages the body is stiffened longitudinally and is held to the framing by two wide plates 4 mm. ($^5/_{32}$ in.) thick, which come up to the bottom of the windows. The greater part of the weight is carried on the front and rear axles, which are the only ones provided with brakes. The center axle, which is lightly loaded and provided with very flexible springs, is used to drive the apparatus. At one end of the car the buffers and couplings are those of an ordinary coach, while at the other they give the dynamometric records. The car contains an apparatus compartment, a drawing room, and a lavatory. An observation clerestory in the apparatus compartment gives a view of the track and the engine.

Dynamometer Buffers and Couplings.

The buffers and couplings at one end are arranged so as to permit the measurement of the difference between the tractive effort on the drawbar and the thrust on the buffers. For this purpose the arrangement shown in Fig. 1 is used. A floating frame is pulled in one direction by the drawbar and pushed in the other direction by the buffer plungers. The movement of the frame is proportional to the difference of these forces, its motion being opposed by the dynamometer springs, the deflection of





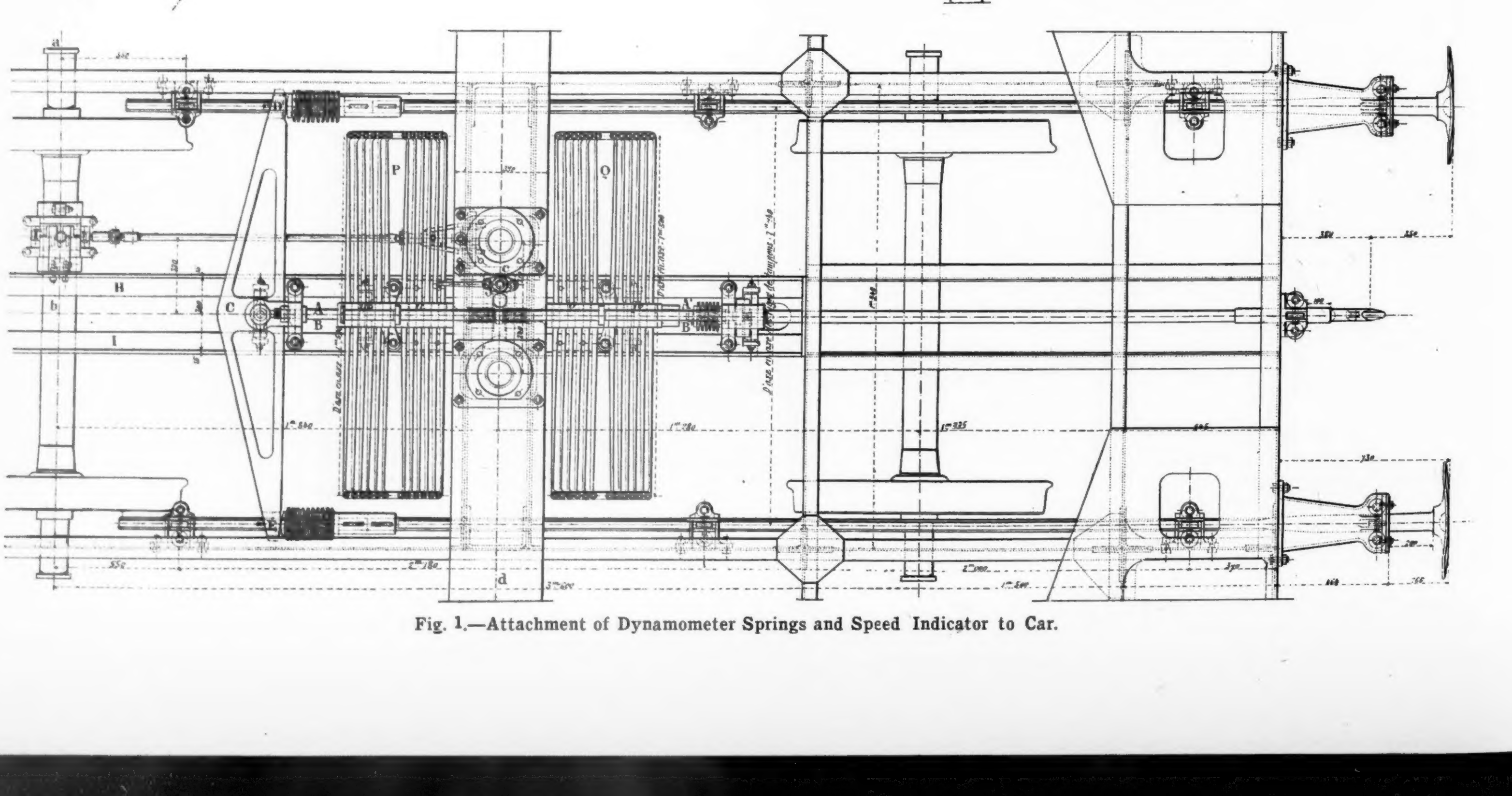
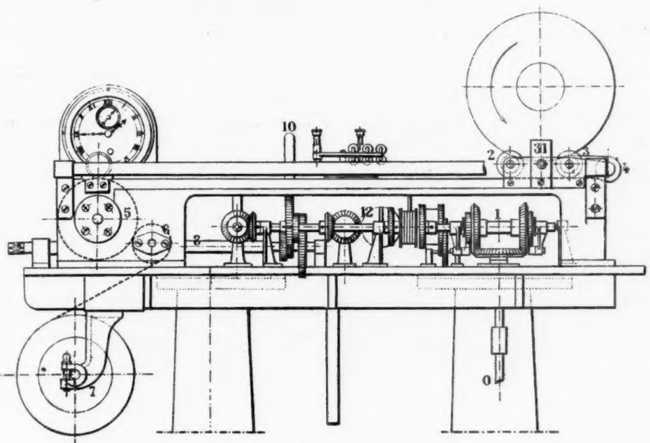


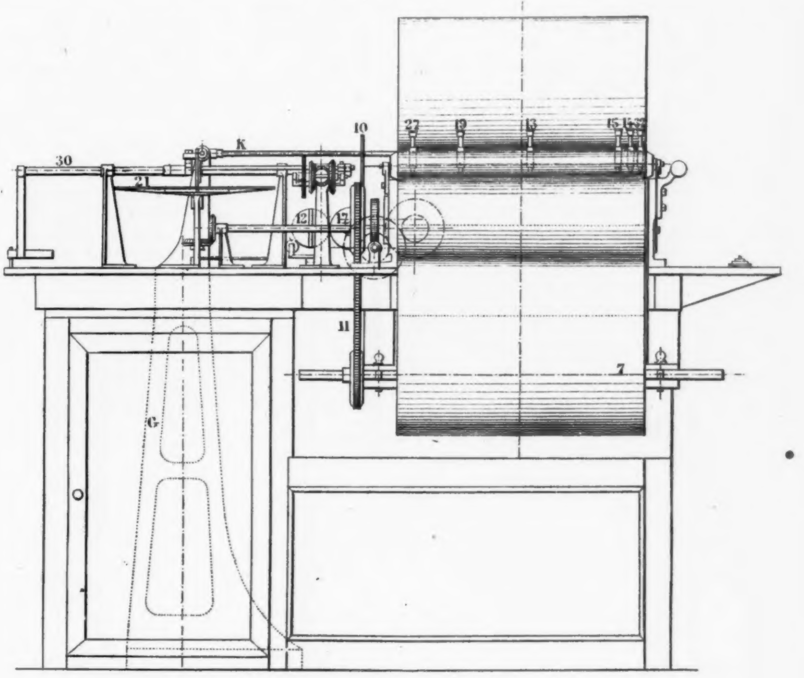
Fig. 1.—Attachment of Dynamometer Springs and Speed Indicator to Car.

which measures the force acting. In Fig. 1 AA^1BB^1 is the frame, which is attached at A^1B^1 to the drawbar and at AB to the center of the equalizer DCE, the ends of which are in connection with the buffer plungers. The frame encloses the dynamometer springs P and Q and acts on them through the lugs ss^1tt^1. The spring Q measures the tractive, and the spring P the buffing force. Each spring is composed of 12 plates, the ends of which are held together by links with an articulated joint for each plate. Each spring is divided into two groups of six plates bound together at their centers by the bands m, n, o, p. When not under tension the two bands of each spring, m n and o p are in contact. The center bands, n and o, are attached to the frame of the car, while the other two bands, m and p, have projections on which the lugs ss^1tt^1 of the floating frame AA^1BB^1 bear. Consequently if the frame is moved to the left, the lugs t t^1 act on the spring Q, while a movement to the right brings the lugs s s^1 to bear on the spring P.

The deflection of the springs measures the force and the curve of tractive force is therefore traced by a pencil attached rigidly to the floating frame, while a fixed pencil traces the zero line. The maximum deflection of the tractive force spring Q corresponds to a force of 10,000 kgs. (22,000 lbs.), and is limited by the block A B coming against the band m of the spring P. The buffing spring P has a maximum deflection corresponding to a force of 5,000 kgs. (11,000 lbs.), and its movement is limited by A^1B^1 coming against p, a coil spring being interposed to break the shock in case of rough buffing. For measuring small forces, some of the plates can be disconnected, thus giving greater flexibility. Adjustment is made by bringing the projections ss^1tt^1 into contact with the corresponding lugs by means of the right and left-handed nut F, which joins the spring bands n and o, and which carries a worm wheel turned by a screw from the interior of the car.



End Elevation of Recording Apparatus.



Side Elevation of Recording Apparatus.

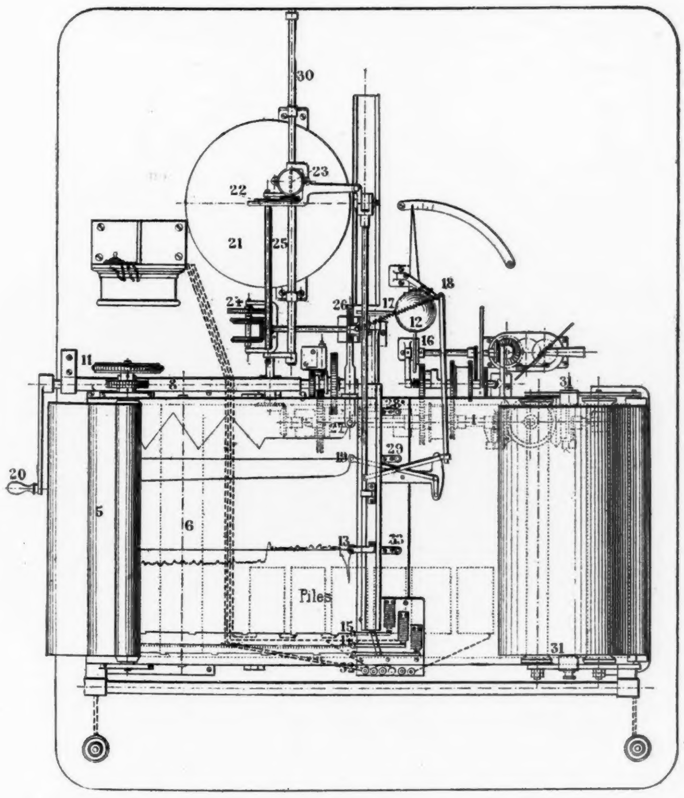


Fig. 4.—Plan of Recording Apparatus.

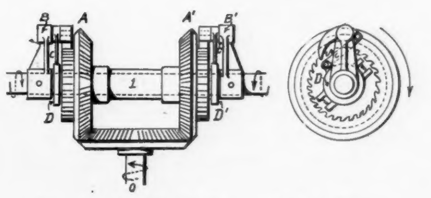


Fig. 2.—Detail of Transmission Gear.

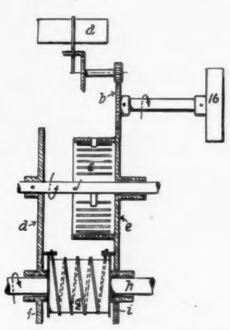


Fig. 5.—Governor Details.

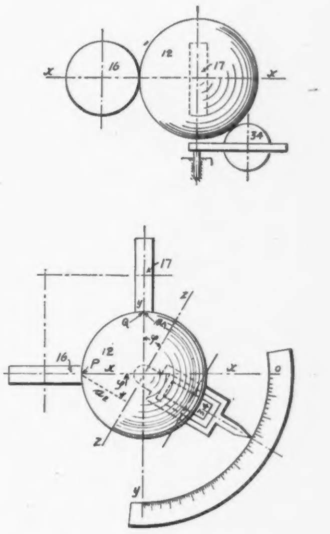


Fig. 3.—Detail of Speed Indicator.

Transmission.

The roll of paper and the speed indicator are driven from the center axle, the transmission being arranged so that the motion is always in the same direction irrespective of the direction of the car, and so that it can be stopped and started from the interior of the car while the car is in motion. The details of the transmission are shown in Figs. 1 and 2. The worm L keyed to the axle drives the worm wheel M, which can be thrown in and out of mesh by the handle T. The wheel M drives, through the shaft N (which has two universal joints) the vertical shaft o. This shaft changes its direction of rotation as the car changes its direction of motion, and this is corrected by the device shown in Fig. 2. The vertical shaft o drives in opposite directions the two miter gears A A^1, which are loose on the shaft 1. Each gear carries a ratchet wheel, both of which have the same direction. The pawls are carried by the supports B B^1, which are keyed to the shaft 1, and the working pawl is held firmly in place while the idle one is held clear of the ratchet and does not click from tooth to tooth. Each pawl is pivoted to its support B and has an extension which is attached by the link C to a collar D, which turns on the ratchet wheel with a certain amount of friction. The link c holds the operating pawl firmly in position while lifting the idle pawl clear of the ratchet.

The shaft 1, which makes one turn to 15 of the car axle, operates the apparatus. The paper is unrolled across a horizontal table on which the curves are traced, being driven from the shaft 1 with two speeds, giving respectively 100 mm. and 500 mm. per kilometer (6.34 in. and 31.7 in. per mile).

Speed Indicator.

The device for determining the speed and recording it on the paper strip, is the invention of Mr. Alfred Amsler. It is illustrated in Fig. 3.

A steel sphere 12 (of about 3 in. diameter), with the position of its center fixed, but so that it can turn freely in any direction about its center, is set in rotation by two friction wheels 16 and 17, which are of the same diameter and which are placed with their axes in the horizontal plane through the center of the sphere and at right angles to each other. The wheel 16 is driven at a constant speed n_2, while the wheel 17 is driven at a speed n_1 proportional to that of the train. The resultant rotation of the sphere takes place about an axis z z, making an angle ϕ with the center line of the wheel 17. From the laws governing the composition of rotations it can be readily shown that

$$\tan \phi = \frac{n_1}{n_2}.$$

That is to say, the tangent of this angle is proportional to the speed of the train which is to be measured. The roller 34, carried in a link pivoted vertically below the center of the sphere, fits the curvature of the sphere, and as it can rotate freely about the vertical axis of the sphere it will always take up a position in which its friction on the sphere is a minimum. This occurs when the axis of rotation of the roller is parallel to that of the sphere. The link carrying the roller is provided with a pointer moving over a suitable scale from which the speed at any instant can be read, and is connected with a pencil which traces the speed curve on the strip of paper. Fig. 4 shows the apparatus complete. The wheel 17 is driven from the main shaft 1, while the wheel 16 is driven at a constant speed by the device described below. To hold the sphere in position a third wheel 18 is pressed against it by a spring. The wheel 16 is driven from the axle of the car at uniform speed of rotation by the interposition of a simple mechanism consisting of a spiral spring and a fly-vane governor similar to that used for music boxes.

Fig. 5 shows the governor mechanism in detail. The spiral spring C, which has one end fixed to the shaft j and the other attached to the barrel carried by the pinion e, tends to turn the friction wheel 16 and the vane a. When running the resistance of the vane and the constant friction of the mechanism are in equilibrium with the tension of the spring, and hence to maintain a constant speed of rotation this tension must be constant.

To keep the tension constant, the relative positions of the pinions d and e, to each of which is attached to one end of the spring, must remain the same, that is to say, the relative positions of the pinions f and i meshing into d and e must remain the same. These pinions f and i run loose on the shaft h (which is driven from the car axle) and are joined by a thread wrapped on the drum g, which is keyed on to the shaft h. When the shaft h is stationary the thread on the drum g holds the pinion i, and consequently the pinion e and the friction wheel 16, from moving. The tension of the spring cannot be reduced because of the inextensibility of the thread. The tension of the spring cannot be increased because this would slacken the thread and permit the pinions e and i to turn independently of the pinions f and d until the

tension came back to that corresponding to the length of the thread.

Measurement of Work.

To measure the work it is necessary to form at each instant the product of force multiplied by distance traveled and to sum the elementary products thus obtained. The apparatus is shown in Fig. 4. A disc 21, driven from the main shaft 1, turns at a speed proportional to that of the train. On this disc runs a friction wheel 22, which is connected with the dynamometer so that its position on the disc depends on the tractive force; when this is zero the wheel is in the center of the disc, and its displacement from this position is proportional to the force. The friction wheel is rotated by the disc and the number of revolutions made is proportional to the distance traversed by its point of contact with the disc, that is to say, to the product of the angular speed of the disc (proportional to the speed of the train) into the distance of the point of contact from the center (proportional to the tractive force). Therefore, by counting the revolutions of the wheel the work done is found. This is done by a small counter 23. Each unit of the counter corresponds to 100,000 kilogrammeters (724,000 foot-pounds). The registering apparatus moves a pencil with a reciprocating motion, each stroke representing a certain amount of work done. The work done during any period is found by counting the number of complete strokes and measuring the ordinate of the unfinished stroke. The apparatus is arranged to record only the positive work done, being thrown out of operation when the buffing pressure exceeds the drawbar pull.

Trucks for High Speed Electric Railroads.

It is but 16 years since the first commercially successful electric railroad of the world was put into operation in the United States. For several years before 1887 electricians had been busy in the attempt to apply electricity as a motive power to cars, and the tardiness with which they achieved success is probably due more to the handicap of inefficient mechanical design than to the defects of the purely electrical portion of the apparatus.

In addition to this there was the conservative element to convince that there was something in the new method of propulsion that would add to the efficiency and economical operation of the road. In short, the attitude of railroad officials was that of indifference and an unwillingness to make any concessions to the electricians in the matter of car construction. The result of this attitude was that it became necessary to apply the electrical equipment to horse cars without any change in the running gear or the strength of the under framing. The consequence of such a procedure is readily imagined, the cars were racked to pieces, the light running gear was broken and the motor suffered every conceivable mishap. It then became evident that a truck was a necessity, and while its use was permitted it was still insisted that the car sills should be maintained at their old level above the rails. But the entering wedge had been driven and the rapid advance in electric railroad construction dates from the introduction and acceptance of the truck as a necessary feature of the equipment.

At first, the speeds attained were more nearly in accord with horse-car practice than they are at present, and for a long time after the system had been accepted as an accomplished fact, the speeds were comparatively low and so continued for a number of years, despite the fact that the air was ringing with reports of actual speeds of from 50 to 60 miles an hour, while 125 miles an hour was the standard talking figures of promoters of new interurban lines.

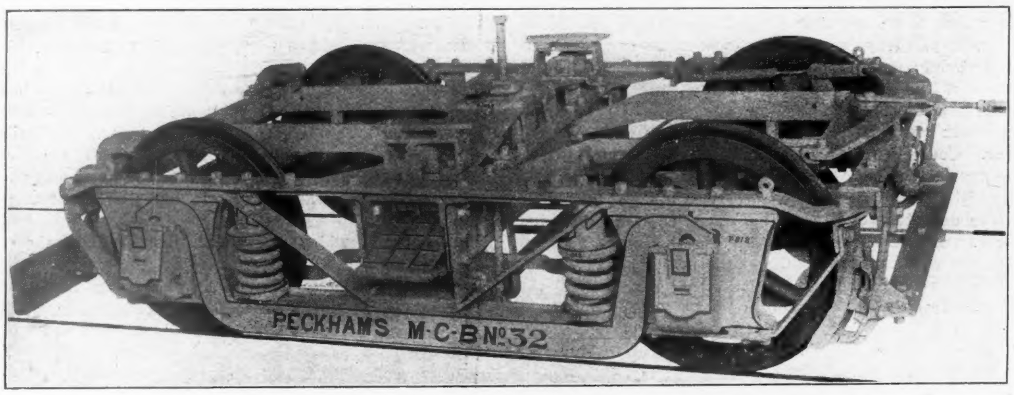


Fig. 1.—High-Speed Truck for Heavy Electric Service, Built by the Peckham Manufacturing Co.

No one doubted the possibilities of attaining high speeds with electric motors, as it was merely a question of power of the motor, but the fact remained that up to 1897 they were practically non-existent. In fact, in that year Mr. Geo. L. Fowler made an examination into the accelerating capacity of the various motors used for car propulsion, for the *Railroad Gazette*, and found that the highest speeds attainable on electric railroads in the vicinity of New York at the time was 22 miles per hour on a straight and level track, though higher speeds were got on steep and favorable grades.

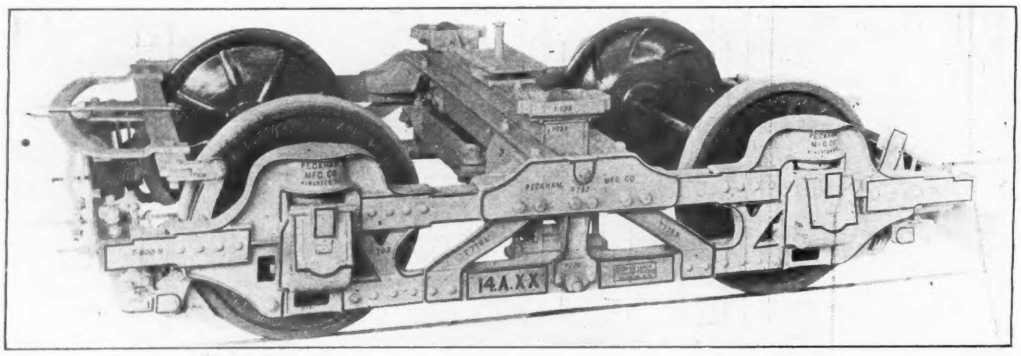


Fig. 2.—Truck for High-Speed Service, Built by the Peckham Manufacturing Co.

Since that time, however, the industry has had a marvelous development, and at the present time speeds of from 40 to 65 miles an hour are matters of every day occurrence, with possibilities of from 80 to 100 miles under especially favorable circumstances. Naturally with this increase of speed there has been a corresponding improvement in truck construction. The short 16-ft. car body of the early days has grown until the full length of steam railroad passenger cars has been reached. The single truck, after being extended and braced to the full extent of which it was capable, has given way to the double or bogie truck, and it is in this form that we find it under all high speed equipment. One prominent truck manufacturer is responsible for the statement that his business in single trucks to be rigidly attached to short car bodies has almost entirely died away owing to the almost universal use of bogie trucks under new cars ordered for heavy traffic city lines and interurban roads, while the smaller companies that use the single trucks are obtaining their supply from the large metropolitan roads that are replacing their single-truck equipment with heavy cars carried on bogies.

In this development of the truck, it is interesting to note the comparatively slight influence that steam railroad practice has had until recently. When the first trucks were put on the market, the cars were light, the motors small, the service slow and the wheels were held in rigid alinement with the body. As there was no precedent in steam railroad service for this practice, and as the building of these trucks was an industry established de novo to meet a special demand, it was quite natural that the designs put out should be along new and peculiar lines. Even in details such as oil boxes and journals the street railroad truck was a law unto itself. It is quite natural, then, that as the weight of cars and their speed was increased the development should be along lines that had their origin in the single truck adapted to cars set but a short distance above the rails, and that the necessity for frequent stoppages should still enforce the adoption of details that will obviate raising the car body unduly above the rails.

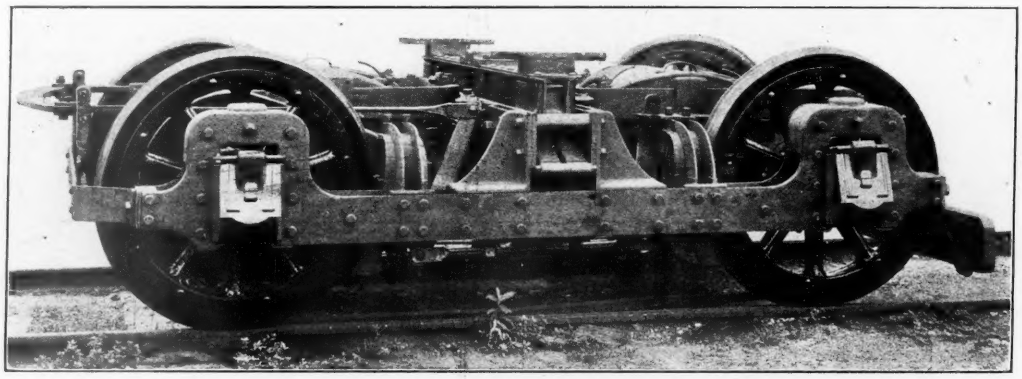


Fig. 3.—Class J High-Speed Electric Truck, Built by the Barney & Smith Car Co.

Still, as electric railroad conditions more nearly approached those of the steam roads, the designers of the rolling stock turned towards the practice of the latter for suggestions and models. This was first shown in the adoption of the steam road journal and box, and later of its brakes, center plates and other details but all with the modifications imposed by the location of a heavy motor on the axle.

This last item has been the controlling element in all electric truck design. With a wheel base that seems to have been limited by common consent to 6 ft. 6 in. and the constant growth in the power of the motor, it has been a problem of no mean difficulty at times, to find room for the transoms, bolsters, springs and hangers between motors that must have a flexible suspension at the nose and be capable of developing 125 h.p., as in the case of the truck of the Peckham Mfg. Co. built for the Chicago, Elgin & Aurora R. R. that was exhibited at the last June conventions at Saratoga, and which was described in the *Railroad Gazette* for Aug. 1, 1902. The point about these trucks that attracted attention was the large diameter of the axles, which was 6 in., a size that was necessitated by the torque of the large motors used, that were intended to run at a speed of 70 miles an hour.

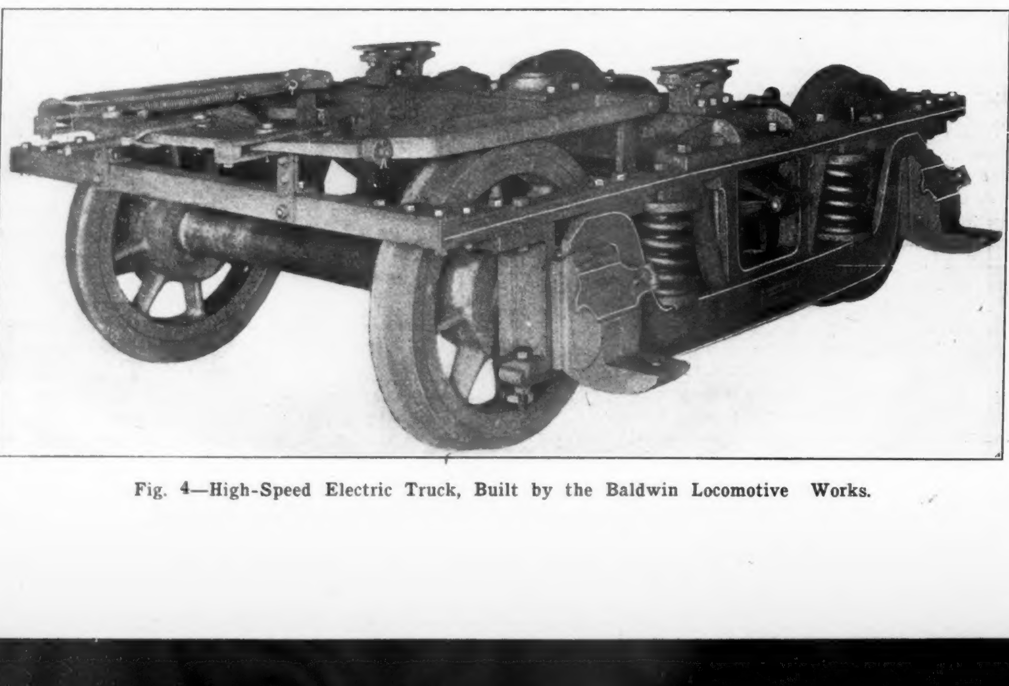
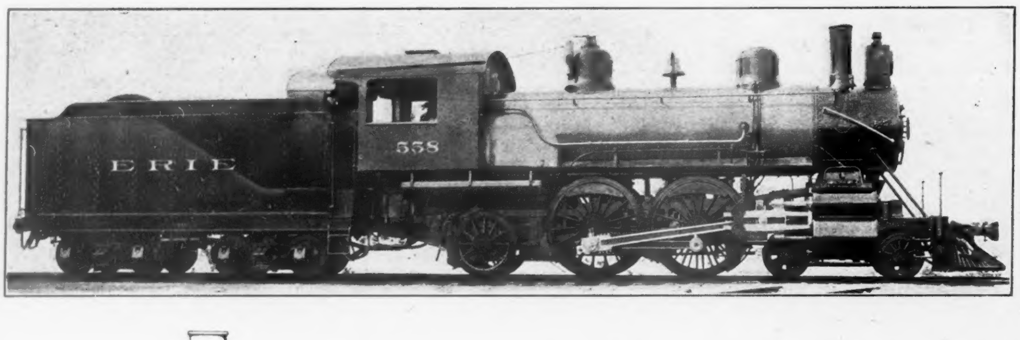
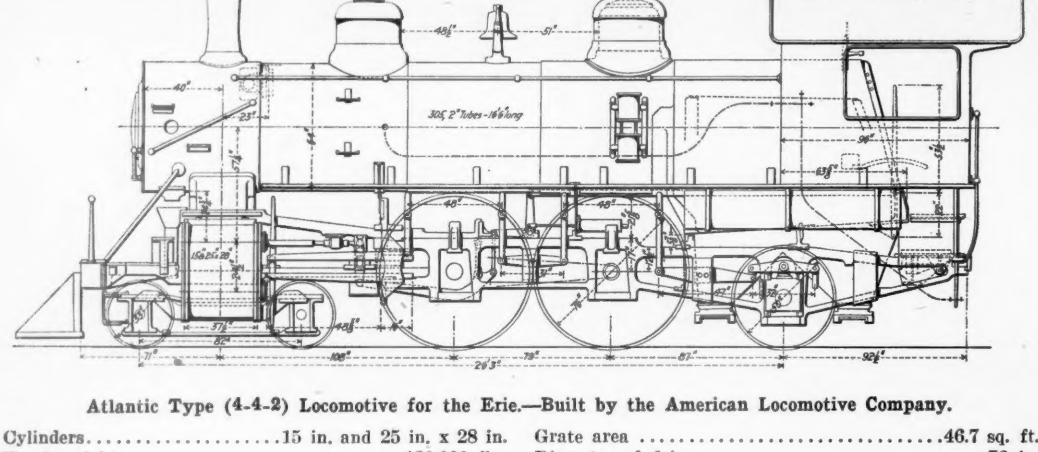


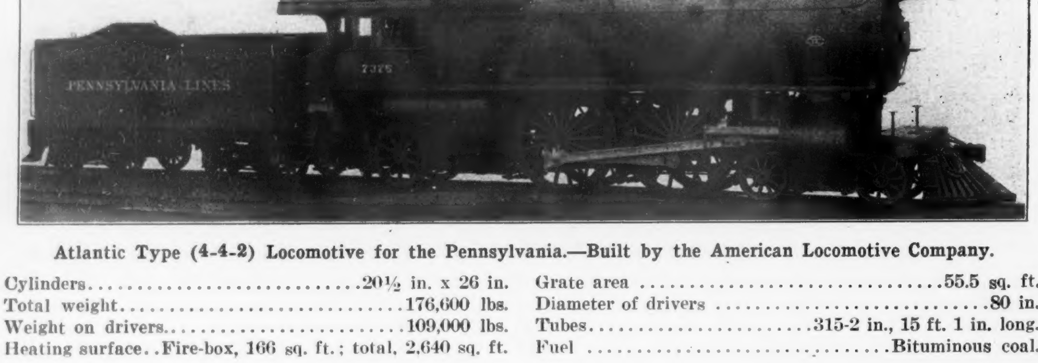
Fig. 4—High-Speed Electric Truck, Built by the Baldwin Locomotive Works.





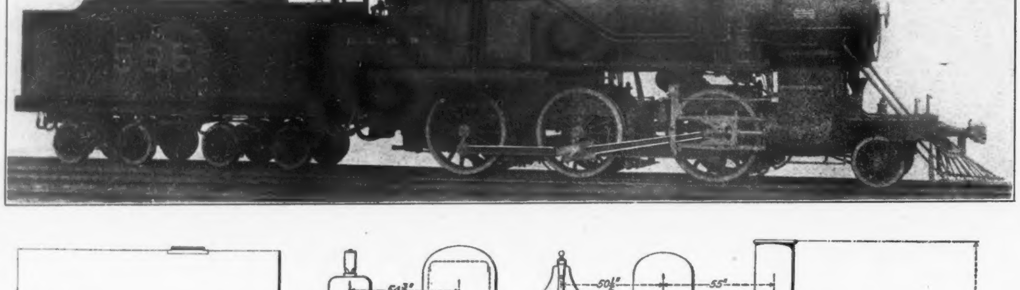
Atlantic Type (4-4-2) Locomotive for the Erie.—Built by the American Locomotive Company.

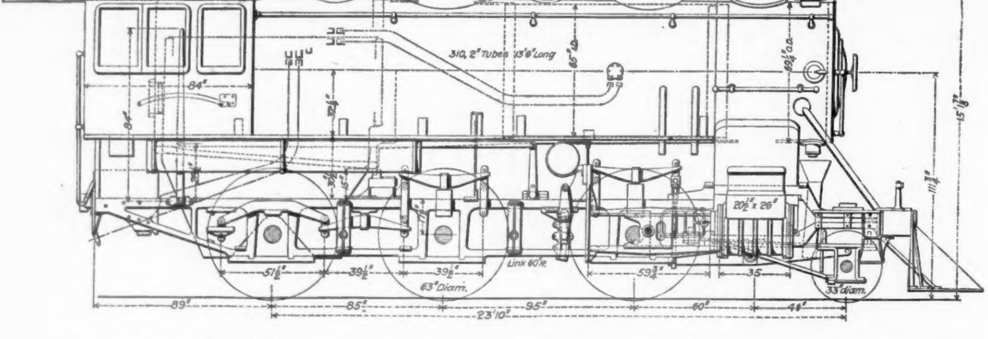
Cylinders....................15 in. and 25 in. x 28 in.	Grate area ....46.7 sq. ft.
Total weight..............................180,000 lbs.	Diameter of drivers..........................76 in.
Weight on drivers......................... 88,000 lbs.	Tubes ....305-2 in., 16 ft. 6 in. long.
Heating surface..Fire-box, 172 sq. ft.; total, 2,811 sq. ft.	Fuel ....Soft coal.



Atlantic Type (4-4-2) Locomotive for the Pennsylvania.—Built by the American Locomotive Company.

Cylinders...........................20½ in. x 26 in.	Grate area ....55.5 sq. ft.
Total weight..............................176,600 lbs.	Diameter of drivers ....80 in.
Weight on drivers.........................109,000 lbs.	Tubes.......................315-2 in., 15 ft. 1 in. long.
Heating surface..Fire-box, 166 sq. ft.; total, 2,640 sq. ft.	Fuel ....Bituminous coal.



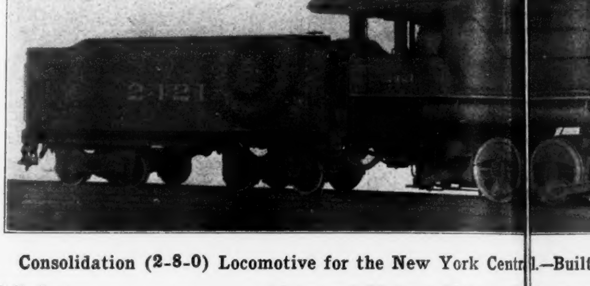


Mogul (2-6-0) Locomotive for the Lackawanna.—Built by the American Locomotive Company.

Cylinders...........................20½ in. x 26 in.	Grate area ....53.4 sq. ft.
Total weight ....161,000 lbs.	Diameter of drivers...........................63 in.
Weight on drivers ....140,000 lbs.	Tubes.....................310-2 in., 13 ft. 6 in. long.
Heating surface..Fire-box, 166 sq. ft.; total, 2,342 sq. ft.	Fuel ....Bituminous coal.

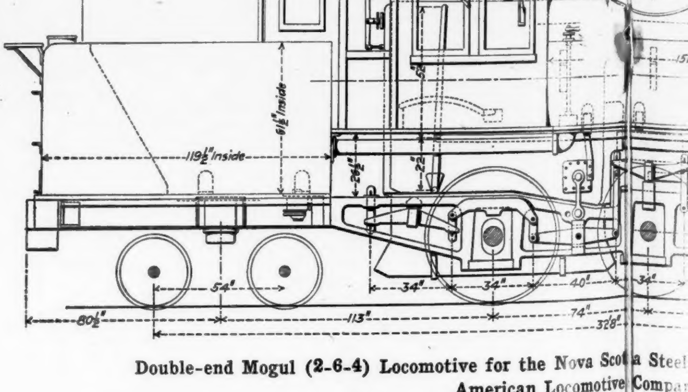
Six-Wheel (0-6-0) Switcher for the Terminal Railroad Asso
Baldwin Locomotive Work

Cylinders..............................20 in. x 26 in.	Grate area
Total weight..............................134,530 lbs.	Diameter o
Heating surface..Fire-box, 170 sq. ft.; total, 1,914 sq. ft.	Tubes.....
Tank capacity..............................5,000 gal.	Fuel .....



Consolidation (2-8-0) Locomotive for the New York Central.—Buil

Cylinders....................16 in. and 30 in. x 30 in.	Grate area
Total weight..............................224,500 lbs.	Diameter o
Weight on drivers.........................198,500 lbs.	Tubes.....
Heating surface..Fire-box, 201 sq. ft.; total, 4,117 sq. ft.	Fuel .....

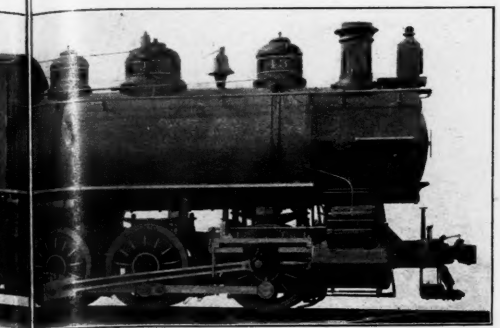


Double-end Mogul (2-6-4) Locomotive for the Nova Scotia Steel
American Locomotive Compa

Cylinders..............................19 in. x 26 in.	Grate area
Total weight..............................172,000 lbs.	Diameter o
Weight on drivers.........................122,000 lbs.	Tubes.....
Heating surface..Fire-box, 125 sq. ft.; total, 1,598 sq. ft.	Fuel .....

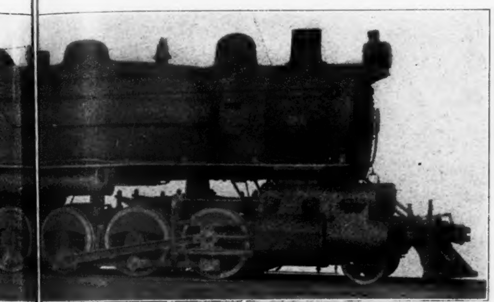
SOME RECENT LOCOMOTIVE

(See article entitled "Tendencies in Locom



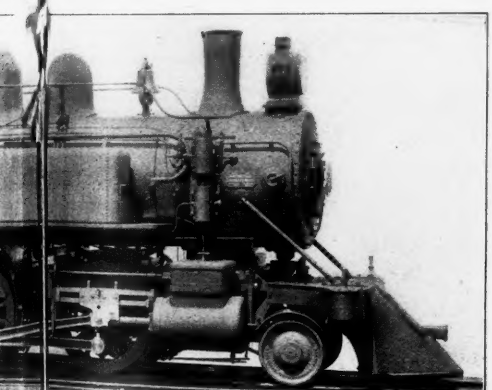
Rai[l]oad Association of St. Louis.—Built by the
omot[i]ve Works.

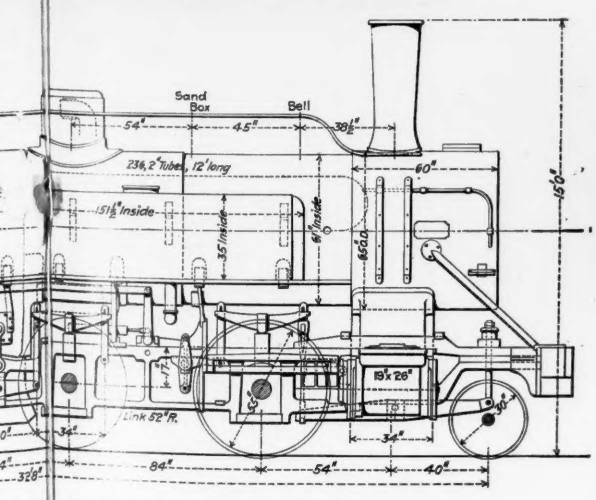
[Gr]ate area	31.5 sq. ft.
[Di]ameter of drivers	51 in.
T[u]bes	323-2 in., 10 ft. 5 in. long.
F[u]el	Soft coal.



Centr[a]l.—Built by the American Locomotive Company.

Gr[a]te area	58 sq. ft.
Di[a]meter of drivers	51 in.
Tu[b]es	507-2 in., 14 ft. 9 in. long.
Fu[e]l	Bituminous coal.



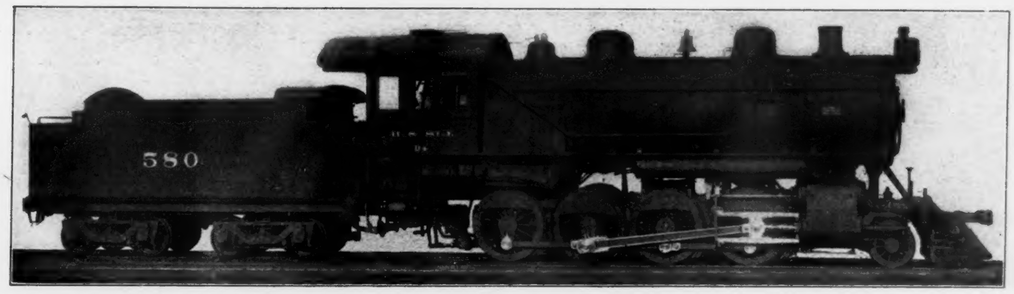


[No]va Scot[i]a Steel & Coal Company.—Built by the
[Loc]omotive Company.

Gra[t]e area	26.2 sq. ft.
Dia[m]eter of drivers	55 in.
Tub[e]s	236-2 in., 12 ft. long.
Fuel	Bituminous coal.

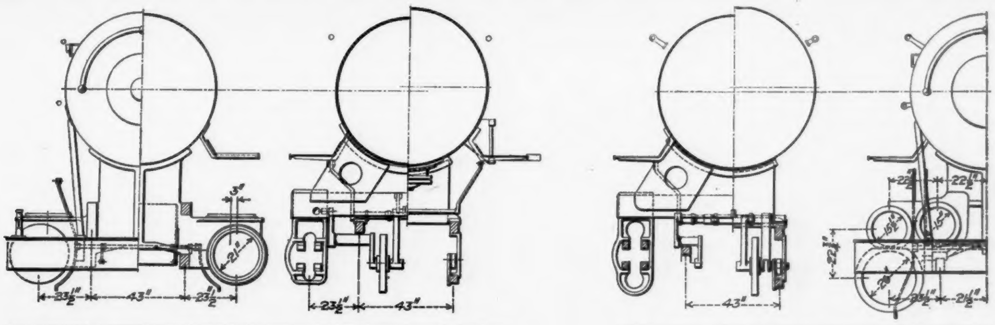
[... ...]T LOCO[M]OTIVES

[...]ncies i[n] Locomoti[ve] Building.")

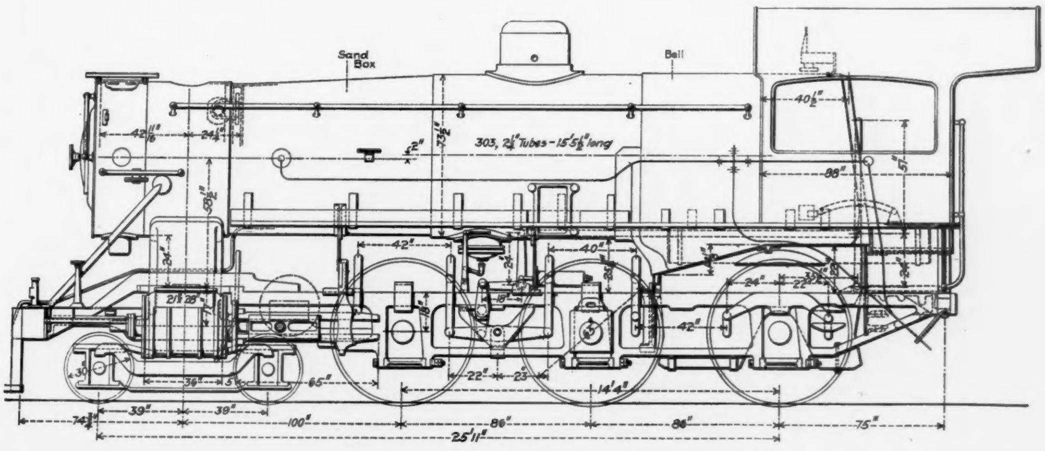


Consolidation (2-8-0) Locomotive for the Hannibal & St. Joseph.—Built by the American Locomotive Company.

Cylinders	22 in. x 28 in.	Grate area	54 sq. ft.
Total weight	207,900 lbs.	Diameter of drivers	57 in.
Weight on drivers	181,000 lbs.	Tubes	462-2 in., 15 ft. long.
Heating surface. . Fire-box, 195 sq. ft.; total, 3,828 sq. ft.		Fuel	Bituminous coal.

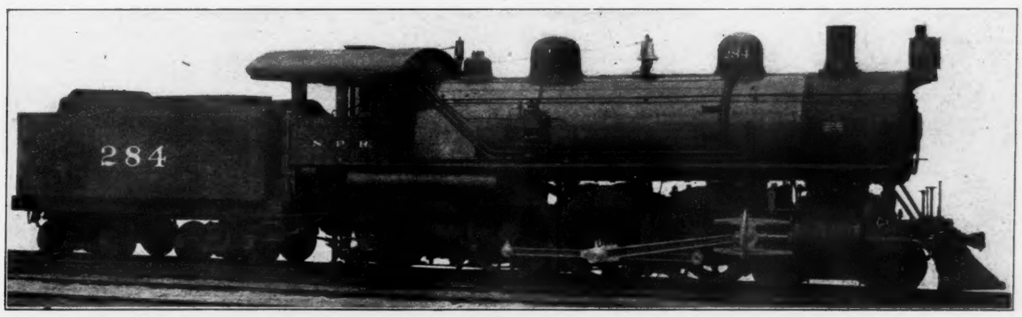


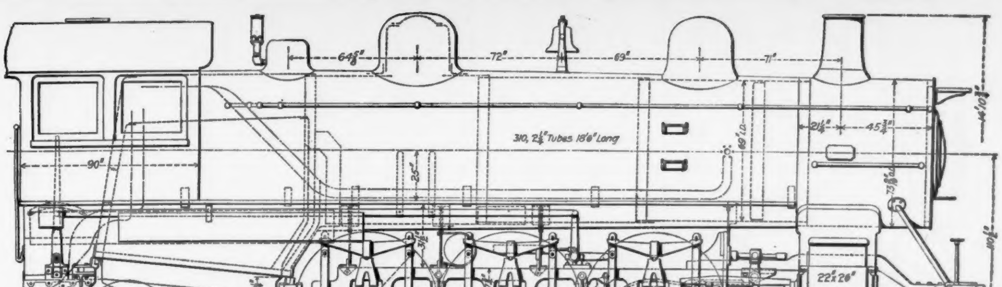
Simple. *Compound.*



Ten-Wheel (4-6-0) Locomotive for the St. Louis & San Francisco.—Built by the Baldwin Locomotive Works.

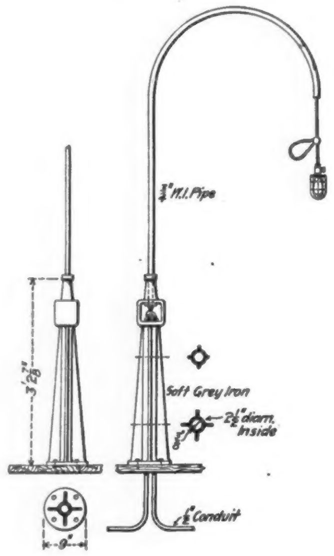
Simple Engines.		*Compound Engines.*	
Cylinders	21 in. x 28 in.	Cylinders	15½ in. and 26 in. x 28 in.
Total weight	186,870 lbs.	Total weight	189,210 lbs.
Weight on drivers	141,490 lbs.	Weight on drivers	141,760 lbs.
Heating surface	2,880 sq. ft.	Heating surface	2,880 sq. ft.
Grate area	43.6 sq. ft.	Grate area	43.6 sq. ft.
Diameter of drivers	63 in.	Diameter of drivers	63 in.



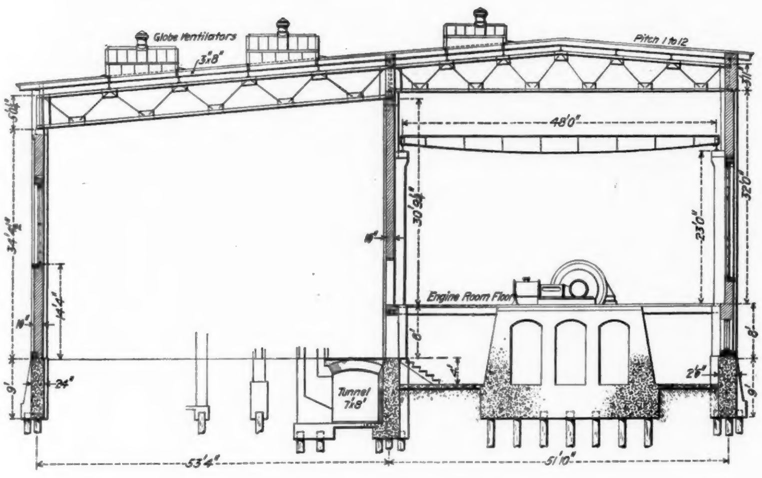


Pacific Type (4-6-2) Locomotive for the Northern Pacific.—Built by the American Locomotive Company.

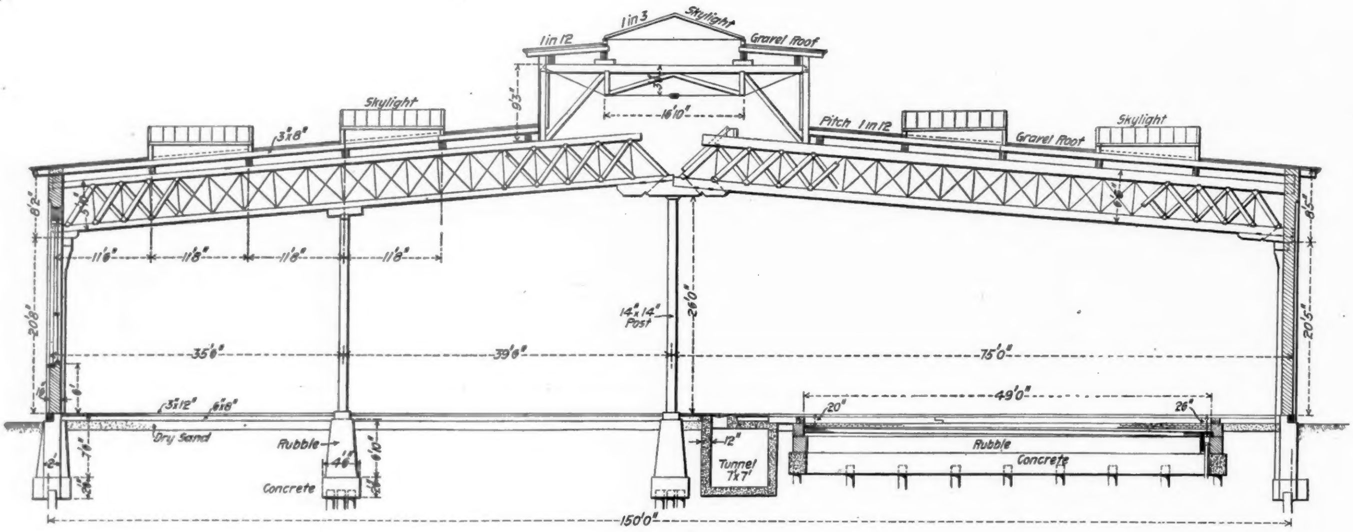
Cylinders	22 in. x 26 in.	Grate area	47 sq. ft.
Total weight	202,000 lbs.	Diameter of drivers	69 in.
Weight on drivers	134,000 lbs.	Tubes	301-2¼ in., 18 ft. 6 in. long.
Heating surface. . Fire-box, 175 sq. ft.; total, 3,462 sq. ft.		Fuel	Bituminous coal.



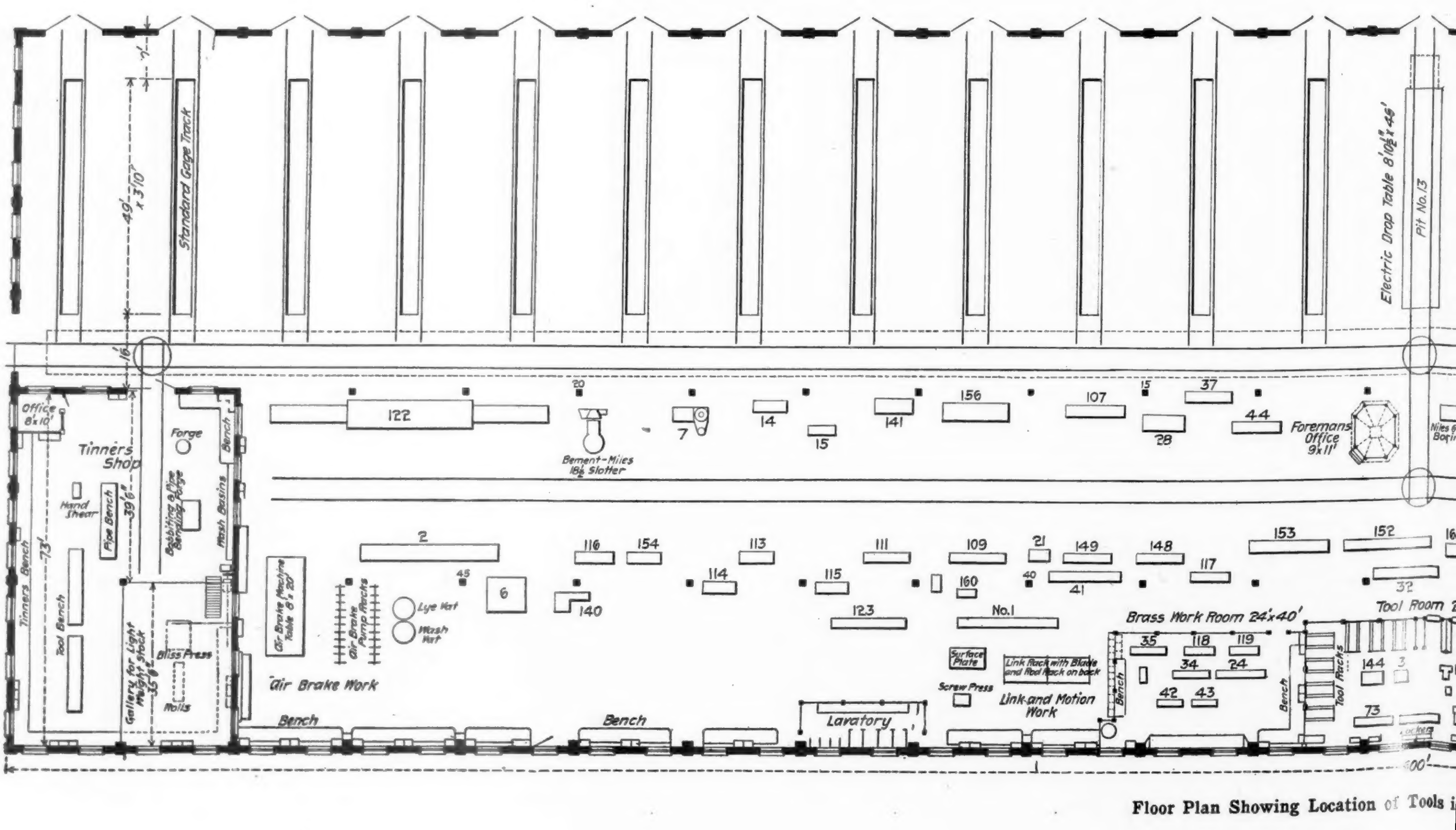
Stand for Incandescent Lamps.



Cross Section of Power House.

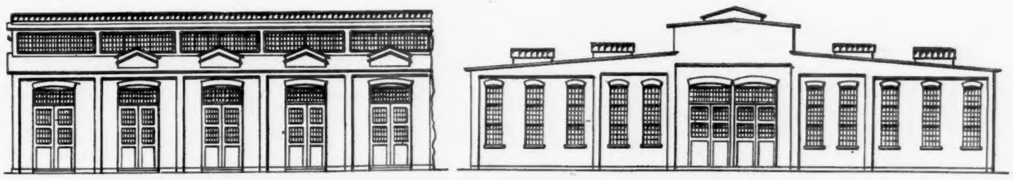


Cross Section of Machine and Erecting Shop.



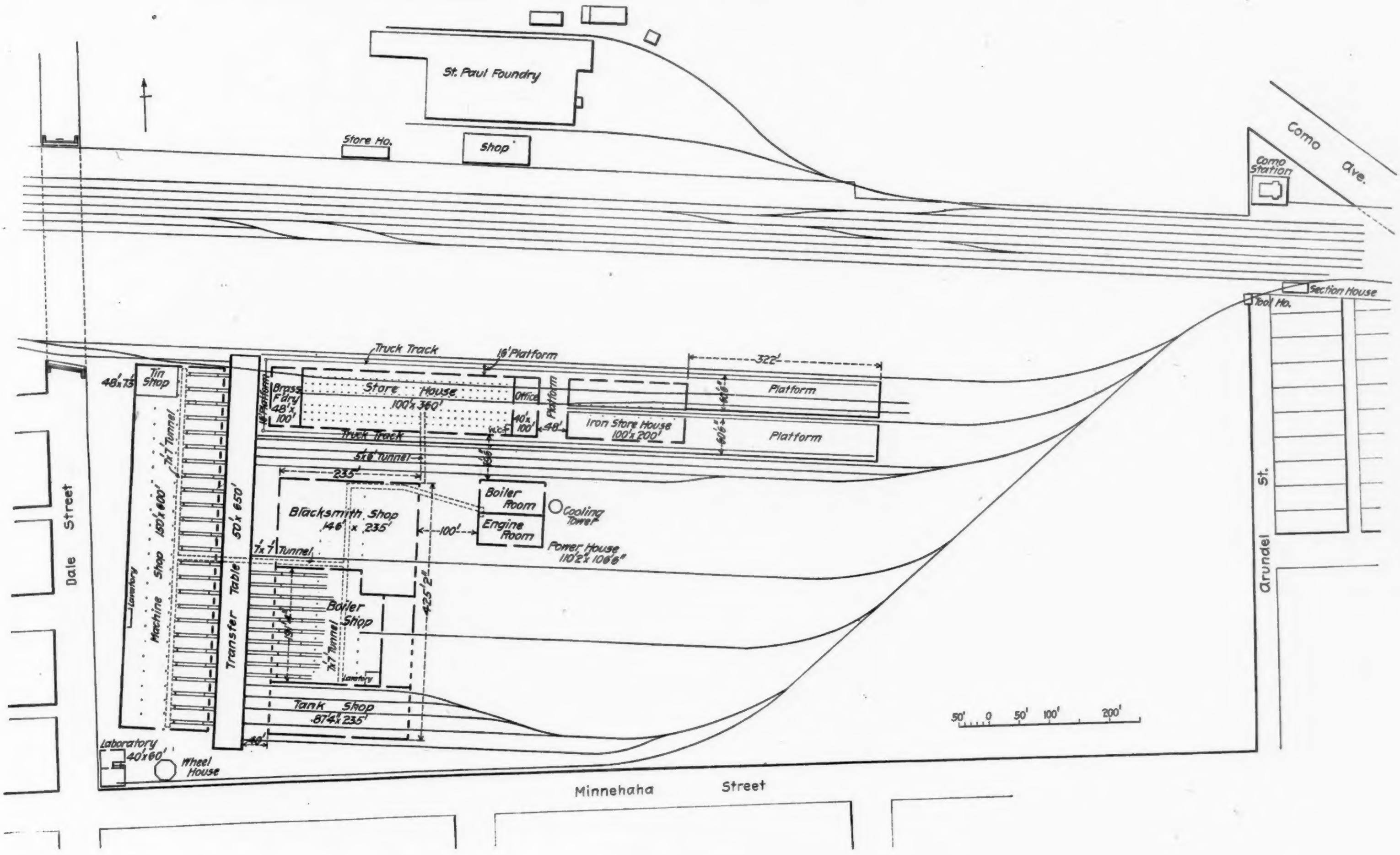
Floor Plan Showing Location of Tools i

ST. PAUL SHOPS OF THE G

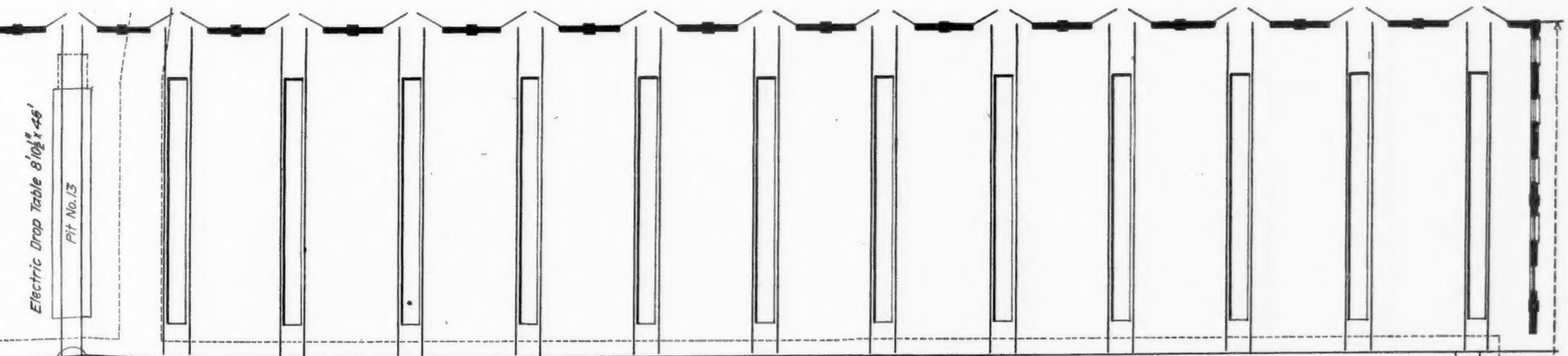


East Elevation. *South Elevation.*

Machine and Erecting Shop.



General Layout.



...tion of Tools in Machine and Erecting Shop.

...PS OF THE GREAT NORTHERN.

Trucks similar to this are in use upon 37 roads in the States of Illinois, Ohio, Indiana, Michigan, Wisconsin and Pennsylvania, where the speeds in regular service are 40 miles an hour or more. Of these roads 19 have schedules of 50 miles an hour or more, two of 60 or more, and one of 70.

Of course all of these high speed cars are carried on bogie trucks, and of these the Peckham Mfg. Co. has two main types. That shown in Fig. 1 is the one most extensively made, and is the same as that exhibited at Saratoga, to which allusion has already been made. It is a modified form of the diamond truck so extensively used in freight service upon steam railroads. It has a flat top frame entirely around the wheels and dropped a trifle at the ends where it is required to avoid low draft timbers, steps or other parts. The load is carried by a narrow bolster suspended from angle or bulb angle transoms, and so designed that, when it is necessary, springs wider than the bolster can be used. This gives the additional space that is often so greatly needed for the motors, where they are large and the wheel base is limited to 6 ft. 6 in. The lower arch bar is carried up over the top of the pedestal and is proportioned according to the load which it has to carry, and up to the present this size varies from ½ in. to ¾ in. in thickness. The transoms are of bulb angles held to a filler that is bolted to the frame and truss bar, and which are held square by broad gussets spreading well out over the top of the frame. In addition to the regular equalizing springs auxiliary pedestal springs are placed upon the oil boxes. These latter carry only a small portion of the load and serve the double purpose of relieving the regular equalizing springs of a portion of the load and to steady the truck and prevent the tilting and subsequent jerking which is so disagreeable on passenger cars when the brakes are applied and released. One of the advantages claimed for this truck is that it has sufficient strength to permit jacking up by placing a jack beneath one of the legs of the pedestal. Trucks using equalizer bars are frequently so constructed that such a process is impossible owing to the stress put upon the upper frame. But in this case the lower arch is so arranged as to permit the maximum capacity of the truck to be carried in this way.

A second type of truck built by the same company for suburban and elevated railroad service is shown in Fig. 2. In this there are no equalizers and the pedestal springs alone form the second series of the spring supports below the bolster equalizers. The pedestals are steel castings with a pocket cast in the crown for the reception of the spring. To this the flat side and end extension bars are riveted, and the whole is thoroughly stiffened by diagonal bracing as shown in the illustration. It will be noted that in both of these trucks, the whole of the space between the end frames and the transoms is left clear for the motor, the brake rigging is placed on the outside with side levers so arranged as not to interfere with the electrical apparatus. The bolsters are very narrow for the reasons already given, and the elliptics beneath are suspended directly by the hangers without the use of the spring plank. As so built the frame is very strong as exemplified in a test to destruction that was made at the shops of the builders some time ago, the details of which were published in the *Railroad Gazette* for Nov. 25, 1898. According to this test, which was conducted by disinterested parties, a permanent set of .03 in. was obtained only after the imposition of a load of 60,000 lbs. on one side frame, or an equivalent of 120,000 lbs. on the center plate, thus demonstrating the strength of this type of construction.

They are generally equipped with steel tired wheels, though there is still a variation in practice. In the early days the cast-iron wheel with a narrow tread of 2¼ in. in width, and a low flange, was used as a direct inheritance of the horse car service. The tread and weight of the wheel has been gradually increased until now the regular M. C. B. wheel and flange is frequently called for. With this increase there has grown up a demand for steel-tired wheels, until the prospects are that, in the not remote future they will be used quite as extensively on high-speed electric railroads as they now are upon the passenger equipment of steam railroads.

The demand has naturally brought out a number of designs that have received a more or less extensive application. Among these is that shown by Fig. 3, which is one that is built by the Barney & Smith Co., of Dayton, Ohio. It differs in all of the essential features of the frame from those previously described, depending as it does for its vertical strength upon the side bars, to which the transoms are directly attached by means of heavy angle castings as shown. The side bars form a double plate frame, with spacing pieces between the two parts to separate them; the one over the axle boxes serving as a seat for the oil box spring, which, as in the Peckham truck shown in Fig. 2, is made to take the place of the equalizer spring, and they seem to do it efficiently. The bolster is narrow to give room for the motor, but it carries broad side bearings to steady the body. The brake rigging, too, is kept out close to the wheels so as to leave all of the space between the same for the motor. Here, too, steel tired wheels with spoked centers are used, a type that seems to find more favor than the plate or solid center wheels that are the more common under steam railroad cars. This truck is in daily service under one of the heaviest interurban electric cars that are running at express train speeds, where it is apparently giving satisfaction.

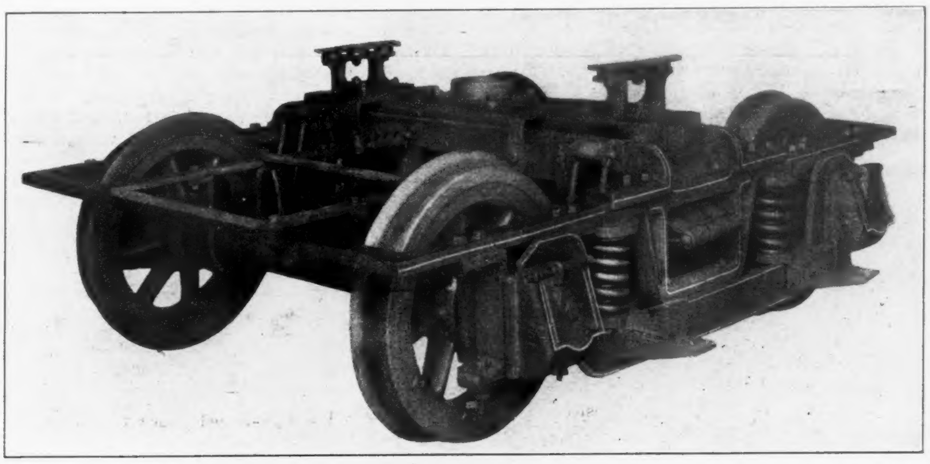


Fig. 5.—Truck for Rapid Transit Subway Construction Co., Built by the Baldwin Locomotive Works.

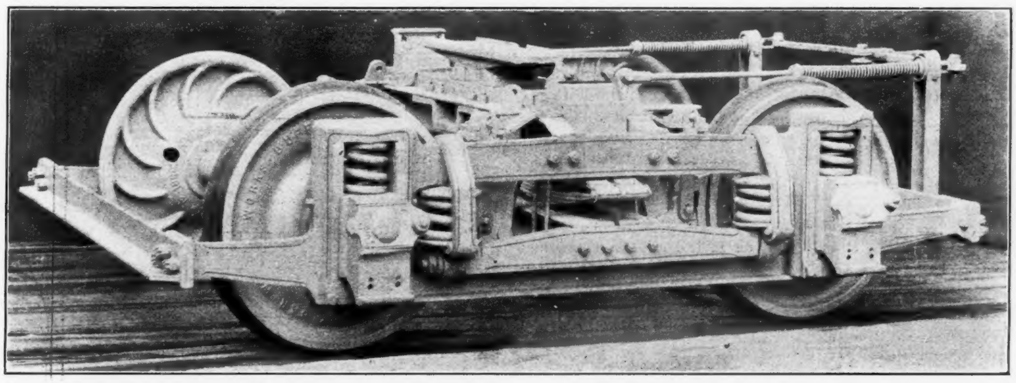


Fig. 6.—No. 27 High-Speed Electric Truck, Built by the J. G. Brill Co.

A third type of truck is shown in Fig. 4, by the Baldwin Locomotive Works of Philadelphia, Pa. This is a development of steam railroad practice and bears many of the ear marks of the front truck of an ordinary eight-wheeled or 4-4-0 locomotive. Of course it is not the same, as witness the outside bearings for the axles, but there is the same heavy frame that must have vertical stiffness enough between the transoms and the equalizer spring caps to carry the whole load, a load that may rise, when running, to 60 per cent. above the simple static load at rest. The pedestals are of wrought iron in two pieces planed on all bearing surfaces, and the transoms are formed of a single heavy steel casting extending out to and over the equalizing springs, thus supplementing the top frame, and, in combination with it, making it possible to carry the load. The equalizer springs are brought somewhat nearer together than in the trucks previously described, a design that while tending to an increase in the carrying capacity of the truck also increases its tendency to tilt under the action of the brakes. As in the other electric car trucks the brake rigging is placed well out on one side; in fact, the levers are central with the wheel and the pull rod is divided and carried out on each side of the wheel. The bolster is a rolled channel and is kept down to the narrowest limits for the sake of giving the maximum available space to the motor.

A modification of this truck has recently been brought out, as shown in Fig. 5. The change consists in making the transoms in separate pieces each with a foot extending out toward its corresponding equalizer spring, and putting a filler beneath the frame which can thus be stiffened by means of a truss corresponding to the lower archbar of a diamond truck. It would seem that a truck so constructed might be made lighter than that shown in Fig. 4, but as a matter of fact it is heavier, but whether this is due to the increase of load and speed or

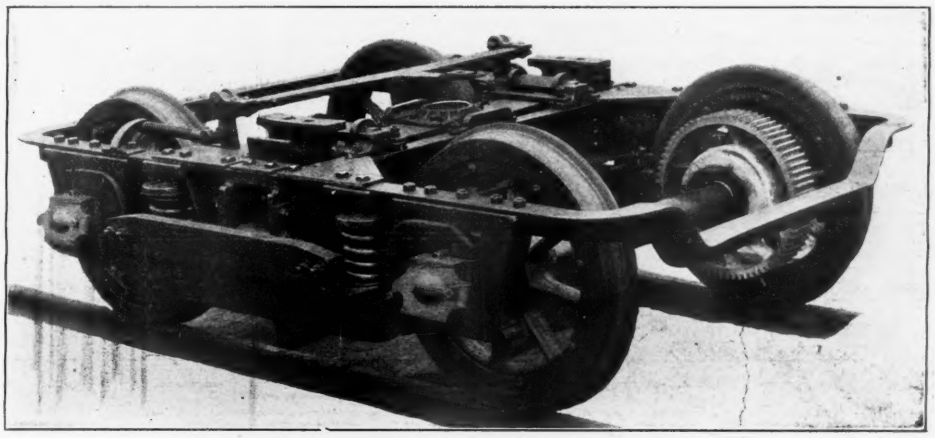


Fig. 7.—Motor Truck for the Manhattan Elevated Railway, Built by the American Car & Foundry Co.

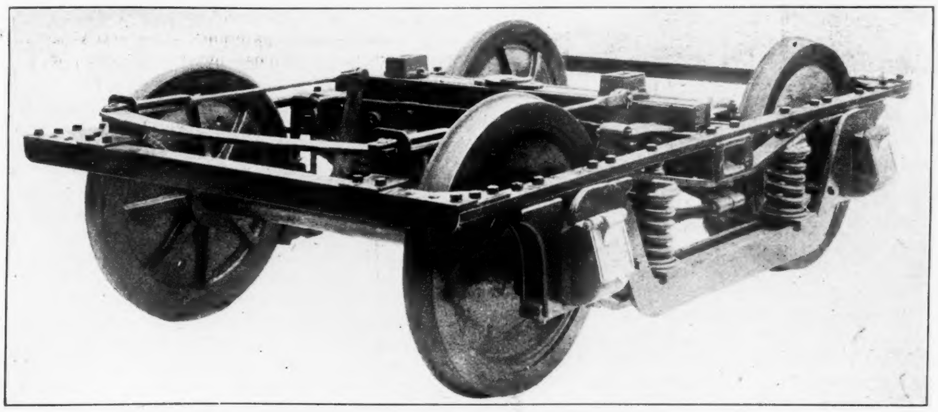


Fig. 8.—High-Speed Riveted Electric Truck, Built by the St. Louis Car Co.

to constructional necessities, the data are not at hand to determine.

There is a fourth type, Fig. 6, by the J. G. Brill Co., of Philadelphia, and which was illustrated in the *Railroad Gazette* for May 13, 1898. The truck is a modification of the standard four-wheeled passenger-car truck that is used on steam railroads, and is the nearest approach to that service in appearance of anything thus far referred to. It was first applied to steam cars running between Jersey City and Philadelphia on the Bound Brook line. It has been somewhat modified from the one used in steam railroad service, and chief among these modifications is the construction of the frame. This is a steel forging or casting, in which the side bars, yokes, pedestals and extensions are all in one piece. The principal feature, however, is to be found in the method of spring suspension. There are three distinct sets of springs practically superimposed the one above the other. First the side frames are carried on the oil box springs, and in turn support the equalizers through the springs in the hangers for the same. Finally the elliptic bolster springs rest upon a spring plank attached to the equalizer, and are loaded with the bolster. The drop in the end frame, the location of the brake rigging and other minor details are made to conform to the requirements of electric railroad construction and operation as already noted in the trucks previously described.

While the five types of trucks thus far described do not cover the whole field, it is believed that they do represent the leading types of what is in service on high speed roads.

Naturally there are modifications of these types, and some of these modifications have received an extensive application. Such a modification of the truck shown in Fig. 1, is shown in Fig. 7, which was designed for use upon the Manhattan Elevated Railway in New York. This fairly comes within the rating of high speed roads because, while the speed of local trains rarely exceed 20 or 25 miles an hour, that of the express trains on the Ninth avenue line rise above 40 on nearly every run. The modification consists in the substitution of an angle for the flat bar of the frame, and the shortening of the truss bar, making it rise more abruptly from beneath the transom and ending over the cap of the equalizer springs. This is an improvement in so far as the capacity to carry a vertical load is concerned, but makes it less capable of standing the stresses imposed by a jack beneath one of the pedestal legs. In addition to this the lessening of the distance between the equalizer springs renders the truck more liable to tilt under the action of the brakes. In this case the transoms are channels held square by a broad ½ in. gusset extending out to a point above the outer edge of the equalizer spring and bolted to a steel filler that takes the place of the columns in a diamond truck and through which true column bolts are passed that firmly hold the frame, transoms, filler, trusses and pedestal tie-bar together. The bolster is made of flat plates ¾ in. thick and 8 in. wide, with the upper or compression member flat. The spring plank is a channel laid flat with the web down and fitted with a filler of wood upon which the seats for the elliptic bolster springs are placed. In the method of spring suspension, hangers for the spring plank and other details, the truck follows the standard steam road practice.

Another modification of this same truck, Fig. 1, is shown in Fig. 8, which is a truck built by the St. Louis Car Co. of St. Louis, Mo. The most noticeable difference between this and Fig. 1 lies in the decrease in the depth of the truss or the drop of the lower arch-bar. Such a change naturally makes a proportional decrease in the carrying capacity of the truck where the same weights of metal are used, and this loss is made up, in part, by thickening the top frame. The latter is formed of flat side bars and angles at the ends, the two parts being held together and square by 9 in. gussets of ⅜ in. steel. The transoms are flat plates 1 in. by 7 in. bolted to the filler lying between the top frame and the truss, and without gussets. The bolster is very narrow, being but 5¼ in. wide over all, and is formed of two 1 in. by 6 in. steel plates upon the outside, with a wood filler between. The brake rigging and other minor details meet the requirements of electric railroad service in the usual way as already noted.

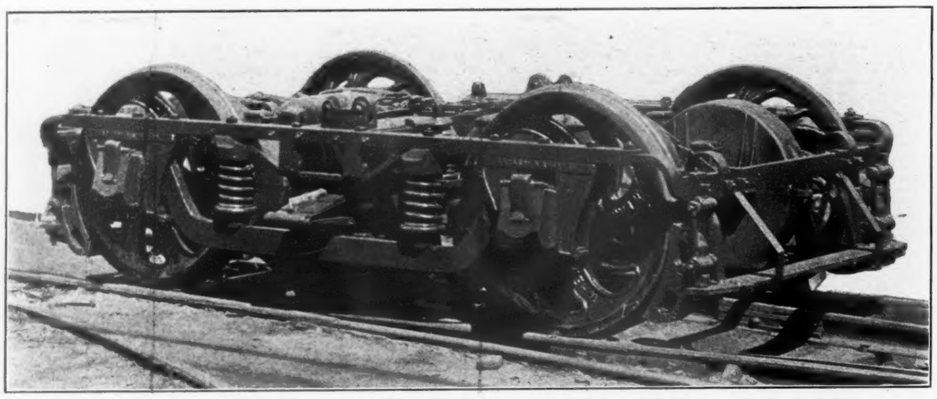


Fig. 9.—Electric Railroad Truck, Built by the Jackson & Sharp Co.

Another modification of this type is shown in Fig. 9, by the Jackson & Sharp Co., of Wilmington, Del. The depth of the truss has been reduced to an insignificant amount, and serves more as a stiffener than for any great amount of load that it can be made to carry. The vertical strength of this truck must, therefore, be dependent on the use of the channel with the web horizontal that is used for the side bars of the upper framing. This also differs from the others of its class in that the equalizer is in one piece instead of two, as in the case of the other trucks. In this case the transoms are of double flat plates of considerable depth, and the bolster is of wood. The same criticism applied to other trucks of its class in the matter of tilting and lack of rigidity when being lifted by a jack beneath the pedestal applies to this one as well as that designed for the Manhattan Elevated Railway.

Fig. 10 is an exceedingly strong construction by the St. Louis Car Co., and belonging to the same type as that of Fig. 2. Here, however, instead of making the yokes and pedestals only, of steel castings and riveting on the side bars, the whole side frame is cast in one solid piece, with ears A at the center to which very deep plate transoms are riveted, which are ¾ in. thick and 16 in. deep. The bolster is formed of two 8 in. channels tied together with cover plates at the top and bottom. The section of the side bar of the frame is a heavy I, while that of the diagonal brace is T shaped. In addition to the elliptic springs carrying the bolsters, the truck frame is carried by two oil box springs at each journal exactly as the old horse-cars were carried where ears were cast upon the side of the oil box to serve as seats for these springs. The end piece is a T shape let into the end of the side frame and held to it by large plate gussets fastened to the two parts by rivets. The brake gear is outside the wheels and the levers are central with the wheels. The pull travels the whole length of the truck and return, with connection rods on each side of the wheels between the lower ends of the brake levers. This is an arrangement somewhat similar to Fig. 4, except that in the latter the bars are upon the top portion of the wheel, while in this they span the lower portion. A heavy pedestal tie-bar completes the truck frame construction. It is evident that this truck has great vertical strength and though it is probably heavy, the general design permits of a suitable distribution of the metal to get the best results.

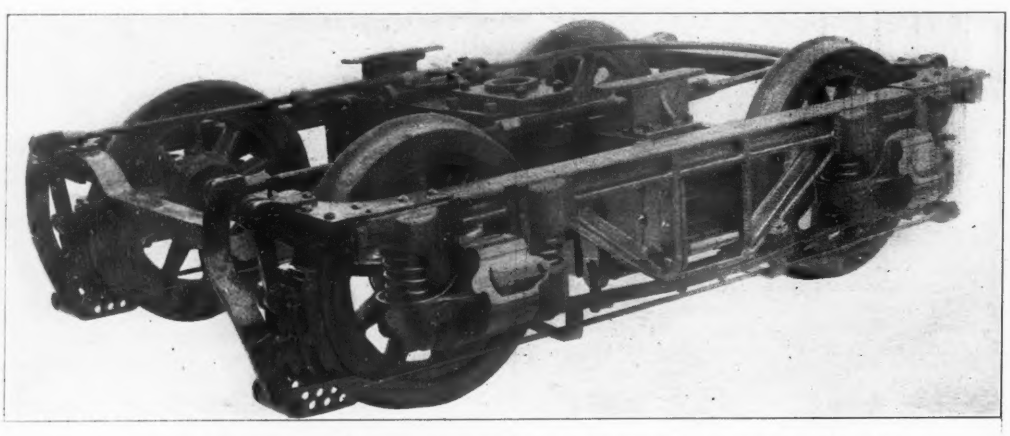


Fig. 10.—Cast Steel Frame Electric Truck, Built by the St. Louis Car Co.

The trucks described do not, by any means, include all that are in use under high-speed electric cars, but they may be taken as typical examples of the best practice. Owing to the manner in which the service and equipment has been developed it is hardly probable that the motor truck will coincide with that of steam road construction for some time to come, although some coincidence may be brought about in the case of trailer trucks to which no motors are applied. The conditions to be fulfilled on a motor truck are exacting and severe. There must be a clear space of the greatest possible area between the ends of the frames, transoms and inside hubs of the wheels; and especially is it important that the wheel hubs should be kept as far apart as possible, and that the distance between axle center and face of transom should be at a maximum. In addition to this, the stresses imposed differ materially from those of the ordinary truck, where the whole burden is placed upon a single center plate relieved to a greater or less extent by the side bearings. Here these same stresses exist, and in addition there is a heavy motor whose weight may be as much as 3,500 lbs. resting directly upon the axle, with a nose fastened to the transom and exerting sometimes an upward and sometimes a downward thrust according to the direction in which the car is moving. The load and torque thus put upon the axle, renders it necessary to use ample diameters, and we have seen them grow from the 3¼ in. under the light, slow speed cars of 1887 to 7 in. under the heavy loads and high speeds of the present. The wheels are still held in position by pressing, keys having been only occasionally used.

Here then we have car axles equal in size to that of the locomotive driving axles of a few years ago, and sustaining shocks to which the latter have never been subjected. That these shocks must be great is at once apparent if we consider that a load of from 1,000 to 2,000 or more pounds is placed directly upon the axle between the wheels without the intervention of any springs, and that the static load must be materially increased by the blow due to uneven rail joints and wheels that are flat or out of round; all of which go towards placing the electric truck in a class that must always remain distinct.

The Merits of Grillage on a Pile Foundation.*

In regard to the relative merits of grillage on a pile foundation and the method of surrounding the heads of piles with concrete several feet below cut-off:

The subject is easily divided into several classes, each of which can best be considered separately. Shallow water sub-structures is the first of these sub-divisions. This includes all sub-structures where the elevation of the footing is fixed by the elevation of low water.

The elevation of the bottom of the footing for the structure in the class referred to (shallow water) is fixed by the elevation at which timber will be preserved. If piles surrounded with concrete are used, it is satisfactory to put the bottom of the footing at low water because that portion of the pile that extends into the footing (generally about 18 in. of the pile) will be kept moist by capillary attraction.

Where grillage is used on a pile foundation, it is not advisable to put the top of the grillage higher than low water because the timber cannot ordinarily be kept moist at higher elevations.

By comparing these two methods of construction, it will be seen that the cost of construction for the former is less than for the latter. The bottom of the excavation for the former (concrete surrounding piles) need only be made to low water, while the excavation for the latter (grillage construction) has to be made about 2 ft. 6 in. deeper. The deeper excavation is required because it is necessary to dig about one foot below the proposed elevation at the top of the piles in order to cut them off, to which must be added about 18 in. for the thickness of the grillage. (The thickness of the grillage referred to is figured on the assumption that 12 x 12 caps and a 6 in. floor are used.) This additional expense for excavation must be taken into consideration, together with the cost of keeping the pit dry, both of which increase more than in proportion to the depth. It is also important to cut off the piles with considerable accuracy to receive the grillage. Carpenters should be employed for this as well as to lay the grillage, while for a foundation where piles are surrounded with concrete it is satisfactory to have ordinary labor do all the work. For grillage foundations it is the regular practice to back fill around the piles and up to the top of the 12 x 12 caps. The expense of re-filling is entirely eliminated in the other case, and a more satisfactory job obtained. The supporting power of the ground can be relied upon to some extent where the concrete rests direct upon the ground, whereas it is doubtful where grillage is used because the back filling is seldom done so that the floor of the grillage rests properly on it.

There is still another class of structures under the heading "shallow water sub-structures." I have in mind those structures that are built into the banks of the river as much above low water as it is considered practicable, and still preserve the timber. In the writer's opinion, the bottom of the footing for structures under this class, either with or without grillage, should be put at the

*A paper read at the April meeting of the Iowa Railway Club by J. C. Hain, C., M. & St. P.

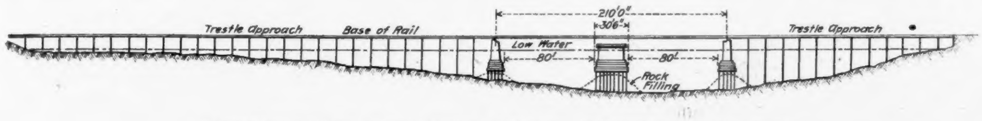
same elevation. The piles that are surrounded by concrete will be preserved at a higher elevation than the grillage timbers, but this additional height is required for the amount that the piles project into the concrete. From this it can be seen that the conditions for these structures are similar to those where the bottom of the footing is put at low water; that is, additional cost is incurred in the construction and a less desirable job is obtained.

Deep water sub-structures will next be considered. This includes those jobs where it is impracticable to use a cofferdam. A good example of this class is the sub-structure for a 200 ft. draw span that was designed and built by the Bridge & Building Department, Mr. C. F. Loweth, Engineer and Superintendent, of the Chicago, Milwaukee & St. Paul, across the Fox River at Green Bay, Wis. It will illustrate the method of construction for a deep water grillage sub-structure. For that reason, I shall describe it somewhat in detail.

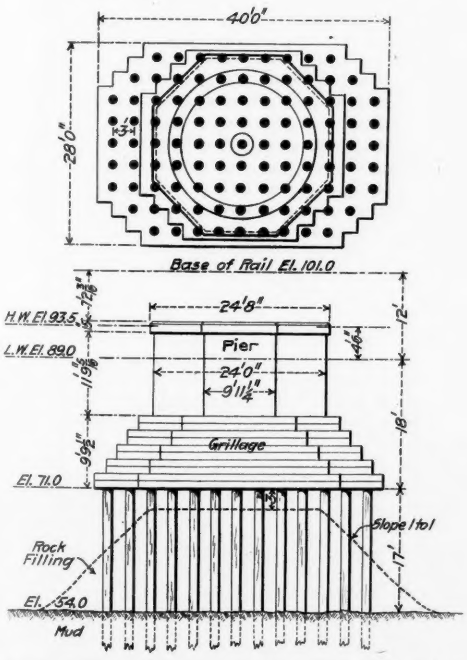
At the location of the center pier of the bridge in question, the bottom of the river was 35 ft. below low water; rock was practically 100 ft. The material above the rock was comparatively soft. These conditions would not permit the construction of a cofferdam. It was decided to drive piles, cut them off 18 ft. below low water, rest a 10-ft. grillage on top of the piles and put a concrete pier on the grillage.

Some of the difficulties of construction encountered are worthy of special consideration. The pier in question was located some little distance from the location of the old center pier so that it was not practicable to drive foundation piles by the ordinary method of track driving. A scow driver was necessary. The expense of rigging up a scow driver for driving the comparatively small number of piles was not warranted. For that reason it was considered advisable to do the pile driving by contract. At best contract work has its disadvantages.

After the completion of the driving, the rip-rapping was done. An attempt was made to place this on the inside and outside of the cluster to within 2 ft. of the cut-off. This was about 17 ft. above the river bed. It thus required the placing of a very large quantity of rip-rap under difficult conditions. The space between the



Elevation of Fox River Bridge—Chicago, Milwaukee & St. Paul.



Detail of Center Pier Foundation—Fox River Bridge.

piles was small; hence much time was consumed, both in placing and removing lodged rip-rap. In fact, it was almost impracticable to deposit this rip-rap according to the plan. One factor which largely increased the difficulty was an agreement to release the tug and scow that delivered the stone in a specified time or pay liberally for the use of the same. To expedite the work special arrangements were made to largely increase the size of the crew for the arrival of the stone. The arrival was very uncertain and resulted, as expected, in the loss of considerable time to the crew.

The piles were next cut off. Special apparatus was used for this. The contractor employed to drive the foundation had an attachment with his driver for that purpose, but it was believed (and rightly, too) that a more satisfactory job would be obtained by using a cut-off machine supported on special falsework, so one was rigged up, and the work was done by the company's forces. It worked well except for the large amount of lodged rip-rap encountered. This caused considerable trouble.

While the other work was proceeding, the grillage was under construction. This consisted of 12 x 12 timbers, laid crosswise. The bottom and top courses of timbers were laid close together. The intervening rows contained about 50 per cent. of voids. Little difficulty was experienced except that great care was necessary in order to get perfect contacts and an absolutely level surface on the bottom. The expense for this work per yard of material, including voids, was practically the same as the cost of concrete. The cost favored concrete slightly. It was necessary to use falsework to place the grillage. A large part of the falsework, however, was the same falsework used for the cut-off arrangement. Only a few additional piles had to be driven. These, however, could not be driven until after the grillage was floated into place.

The caisson built on top of the grillage was of very simple construction, and the lowering of grillage was accomplished by depositing concrete in the caisson. No difficulty was experienced. The caisson was practically dry after being properly caulked.

The end piers of the draw span were similar in construction to the center pier except that they were narrow and long instead of octagonal. The same processes were gone through in constructing these piers as was described for the center pier except that greater precautions were necessary to lower them to place. They had a greater tendency to overturn on account of their oblong dimensions. For that reason, it was necessary to build a more extensive falsework and arrange for lowering jacks. This lowering required a crew of eight men constantly employed when the concrete was being deposited, and until the pier was landed.

Intermediate sub-structures will be taken up next. There seems to be no question which system is preferable for the two classes already considered (shallow and deep water sub-structures). It is difficult, however, to decide which of the two systems should be used for the "intermediate" class. Generally, it is a question of cost that prompts the selection of one of the two methods.

In reaching a decision by comparative estimates, the driving of foundation piles may be omitted, it being common to both, except that perhaps more piles should be used with a grillage in order to get the same supporting power. In other respects, the following may be taken into consideration:

For concrete surrounding piles estimate labor, material and apparatus for constructing cofferdam; labor and apparatus for pumping; labor for excavating; labor of cutting off piles (by hand); labor and material for additional concrete, and labor and material for rip-rapping.

For a grillage, supported on piles, estimate labor and material for rip-rapping around and between piles; labor, apparatus and falsework for cutting off piles; labor, material and falsework for making, launching and lowering grillage, and labor and material for constructing caisson.

There is a depth of water beyond which a grillage will be most economical. However, this will vary with the total amount of work to be done, because it is a large factor in reducing the cost of special apparatus for construction.

Not unfrequently, however, consideration is given to the relative desirability of the two classes of construction, either because of the merits of one system, or because the difference in cost is a nominal consideration.

As to the relative desirability, in the writer's opinion (other things being equal), a grillage construction is less to be advocated than the other. It has no support on a natural foundation. There is a greater possibility of settlement due to open joints or improper bearing on piles. Being supported in the water above the ground line it is less stable from impacts of floating material, and lastly, it is also subject to erosion and water insects.

Russian Railroads in 1902.

A preliminary report on the railroads of Russia for the year 1902 shows that at the close of the year there were in operation in all Russia 37,681 miles, of which 4,961 miles were in Asia. Of the total 25,893 miles, or more than two-thirds, are State railroads, including all the mileage in Asia and all in Finland, though the Finnish railroads are the property of the grand duchy and not of the empire. Nearly 6,000 miles of railroads were opened for traffic, most of it provisionally, during the year; but most of this had been built before. Investigations and surveys for 3,330 miles of new railroad were authorized during the year.

The gross earnings of the railroads in Europe increased a trifle over 3 per cent. This preliminary report does not give mileage of passengers and tons of mileage, but only their number, showing an increase of 7.4 per cent. in number of passengers and 7 per cent. in tons of freight, which would be very large for a country like Russia, but for the large increase in mileage. There is reason to suspect an error in the figures in the German summary which is our source of information, as the State Railroads, with more than 60 per cent. of the mileage, are credited with but 16 per cent. of the passengers and 19 per cent. of the freight, and yet with 71 per cent. of the earnings, and moreover on them is reported a decrease of 10⅔ per cent. in the number of passengers carried, against an increase of 11½ per cent. on the private railroads.

The movement of coal was almost exactly the same in 1902 as in 1901 (868,000 carloads, the car having capacity for 27,000 lbs.), and there was a slight decrease in the quantity of petroleum and its products; but the shipments of grain to seaports and stations on the border (nearly all for export) increased no less than 23 per cent., and amounted to 571,077 carloads, which would be equivalent to 257,000,000 bushels of wheat. It is noticeable that Archangel, which is intended to be the port for exports of Siberian grain, received but 502 carloads in 1902, against 2,472 in 1901.

The Berlin-Zossen Speed Trials.

At last provision is to be made for strengthening the track of the Prussian Military Railroad between Berlin and Zossen in order that the experiments with extraordinary speeds may be continued. It will be remembered that after reaching a speed of 99.4 miles an hour in the experiments last year, it was found unsafe to increase that speed until the track should be made stronger. But it was necessary to wait for an appropriation by the Prussian Parliament. The amount of $72,000 has been appropriated, and the work is to be begun directly. For the present 67 lb. rails 82 lb. rails will be substituted, the latter borrowed from the Prussian State Railroads, laid on new fir ties with hardwood plates, 18 to the rail (presumably 10 meters = 32.7 ft. long), ballasted with fine broken basalt—hardly the weight we would choose for a speed of 150 miles an hour. The line is 14¼ miles long. Besides the new electric locomotives, two steam locomotives are being built to compete with them. The whole railroad world should watch these trials, which will be likely to show what is practicable in the way of speed as has never been done before.

Superheated Steam in Locomotive Service.

III.

Concluding Discussion.

Having in the two preceding articles considered the principles underlying the design of a locomotive for using superheated steam, and having briefly described the peculiarities of the Schmidt locomotive, we may, in conclusion, consider what are the chances which such an engine has to extended use.

The prediction of Professor Peabody, already quoted, to the effect that all superheating devices will in the end be discarded, is doubtless generally accepted by the rank and file of American engineers. For them, the problem has no mysteries. They understand the thermodynamics of the problem. They know that experience through many years has proven to them that the use of superheated steam in engines is always attended by a more efficient cylinder action. But they know that in all past experience, the difficulties in maintaining a superheater have proven too great to justify their use, and they believe that since this was true 30 years ago when steam pressures were so low that the temperature of the superheated steam of that day, did not need to exceed the temperatures of high pressure saturated steam of to-day that the problem of superheating is now vastly more difficult than it has ever been before. The prevalence of this view in this country naturally leads many to question whether even Germany's great progress is yet sufficient to insure the future of the practice. In all this, it is not intended to minimize the value of the researches of Schmidt, Schroter and other German investigators. The endeavor has been to make the fact clear that between even masterful and apparently most promising experimentation and an assured success in practice, a broad gulf is fixed, and that the voyage across is not yet finished.

Turning now from convictions based on previous experience, and approaching the subject without prejudice, it is well, first of all, to recognize the fact that when a principle in operation is correct and when it is generally understood, it is never safe to assume that the means whereby it may be utilized will forever fail to be forthcoming. The reverse is likely to be true. The efforts to use superheated steam in the cylinder of an engine are based upon correct thermodynamic principles and hence sooner or later practice will embrace it. Again, it goes without saying that with the better materials and larger experience of to-day, the problem of producing and utilizing superheated steam can be approached with greater certainty than was possible in the practice of many years ago. Proof of this is to be seen in the success of the Germans, who have certainly advanced their practice beyond our own, for excepting a few installations of the past year or two, our activity virtually ceased a quarter of a century ago, while theirs is more apparent now than ever before. In view of all this, we should be doubly careful to avoid the fault of being slow to appreciate the merits of their devices.

Thus warned, we are prepared to consider what are the merits of the Schmidt locomotive, and to note that reports of their performance which have been published not only show a gain in efficiency, which is generally stated to be equal to 25 per cent., but also, that they give no trouble in respect to cylinders or superheaters, the service in the case of one engine covering a period of two years. These are significant results and if they can be obtained in Germany, why not in America?

Examining the design more in detail, we shall find in favor of the Schmidt locomotive a condition more favorable to the use of a superheater than any which have ever been tried in this country. The installations with which we have hitherto dealt have served in stationary or marine practice. The superheater of these plants has either been a separate boiler-like device in which no

water was carried, or has been so combined with the boiler as to always be in close communication with its furnace. Under these conditions, when the engine throttle is closed, the circulation of steam within the tubes ceases and the metal of the tubes together with the entrapped steam within them remain exposed to the undiminished intensity of the furnace action. In this manner the tubes are often heated to very high temperatures, a result which when often repeated leads necessarily to a failure of the superheater. Again, when after an interval of inactivity, the engine is started, the steam which has been held back within the superheater until it has been raised to an enormously high temperature, passes on to the engine, oftentimes retaining enough of its heat to burn the lubrication and sometimes the rod packings. But all difficulties of this class which to a greater or lesser degree have appeared in the operation of every stationary engine plant using superheated steam, are doubtless avoided in the Schmidt locomotive. In this machine, as in other locomotives, the rate of combustion varies with the volume of steam used. When the throttle is open, the fire burns brightly; when it is closed, its activity is at once suppressed. When there is no steam passing within the tubes of the superheater, the gases circulating around the tubes are comparatively low in temperature, and when the conditions are so changed that the temperature of the gases becomes maximum, the volume of steam passing the tubes is greatest. Just as the draft responds to the varying demands which are made upon the boiler, so the volume of heat which is available for superheating varies with the quantity of steam which is to be superheated. The details of the design provide that when the blower is on, dampers are closed which prevent the circulation of gases in the superheater so that it is only when the throttle is open that the superheater does work. This would seem to make impossible any overheating of the superheater. In view of the highly favorable character of all these conditions, it is likely that it will be found easier to maintain a superheater of the Schmidt design on a locomotive, than in connection with any other type of engine, and, moreover, that the superheating in locomotive service may be a pronounced success, while in other classes of service its future is still problematical.

In conclusion, therefore, it appears that the performance of the Schmidt superheater is satisfactory, that the mechanical arrangement presented by its design is one of unusual merit, and that its use does not involve undue cost for maintenance. If all this is true then its value as a means of increasing locomotive efficiency, must be very great; and its importance and promise are such as to merit far more attention than has yet been bestowed upon it by American engineers.

W. F. M. G.

Applying a Motor Drive to an Old Lathe.

The photograph and diagrams which are given below, showing the method of adapting an old 60-in. engine lathe to a motor drive, have been obtained through the courtesy of Messrs. Dodge & Day, Modernizing Engineers, Philadelphia.

As there is considerable difference of opinion among engineers concerning the advantages resulting from an equipment of the kind to be described below, it may be well to point out briefly the utility of such an equipment and the general type of management required if the anticipated advantages are to result.

The spindle speeds will differ by but 10 per cent. increments and, as the workmen have no means for intelligently using such a refinement in speed, it is necessary to instruct them through "instruction cards" issued by a Planning Department who lay out the progress of all the work through the shop as well as the details of machining.

The proper cutting speeds and feeds are arrived at from a consideration of the blue prints showing the amount of metal to be removed, together with a knowledge of the characteristics of the tool steel and the material to be machined. If the lathe is to operate at a maximum efficiency it must have sufficient power available to load it to its maximum working value, but, at the same time, care must be taken that the gearing is not broken, with a consequent delay and loss of money. For this reason it is necessary to make a careful and systematic analysis of the strength of gears, rigidity of the frame work, etc., and in many cases it is found that certain especially weak parts can be replaced by new ones, greatly increasing the efficiency of the machine. There are, of course, instances where a tool will be amply strong so that the size of the motor will be based upon the work in view, but this is rarely the case when equipping old machines.

Table 1.—Strength of Gears of Old 60-in. Engine Lathe.

No. of teeth.	Diametral pitch.	Face of gear.	Velocity.	Diam. of pitch circle.	R. p. m.	Tangential strength by slide rule.	Strength at tool.
"A" reduction.							
	In.	In.	F. p. m.	In.		Lbs.	Lbs.
18	2	3½	250	9	106.1	5,300	79,000
56	2	3½	250	28	34.1	7,000	104,400
12 s	2	6	54	6	34.1	23,000	73,400
62	2	4¼	54	31	6.6	11,000	35,100
11 s	1¼	5¾	15.4	8.8	6.6	35,000	31,700
68	1¼	5	15.4	54.4	1.066	24,200	21,900
"B" reduction.							
41	2	3½	570	20.5	106.1	4,900	47,600
33	2	3½	570	16.5	131.8	4,600	44,600
12 s	2	6	215	6	131.8	18,500	65,200
62	2	4¼	215	32	25.5	8,900	31,400
11 s	1¼	5¾	59	8.8	25.5	33,000	32,000
68	1¼	5	59	54.4	4.13	22,700	22,050
"C" reduction.							
11 s	1¼	5¾	245	8.8	106.1	23,000	92,700
68	1¼	5	245	54.4	17.15	15,800	63,600

The lathe under consideration was driven from a countershaft bolted to a wooden framework projecting into the main bay of the machine shop. In order to obtain the necessary number of spindle speeds three belts from the line shaft were used, giving 20 speeds in the forward direction and 10 speeds in the reverse direction. A photograph of the lathe is shown by Fig. 1 and a diagram of the gear and pulley arrangements is shown by Fig. 2. The table accompanying Fig. 2 shows the spindle speeds possible by the old belt arrangement. It will be seen that the spindle speed could be varied from .64 revolutions per minute to 119.1 r. p. m. by shifting the belt on the line shaft and countershaft, and on the several steps of the cone pulleys and by putting the back gear in or out. A large range of speeds is thus available, but it is impossible to obtain a uniform and easy variation of speeds without the necessity of shifting heavy belts, thereby losing much valuable time.

The first step in the process of modernizing this machine was to analyze the strength of each gear in the entire train. This analysis is shown by Table 1, which gives, in convenient form, the data referring to each gear and the tangential strength as determined by means of a slide rule, based on the formula of Mr. Wilfred Lewis. The group of figures entitled "A Reduction" shows the strength of the gears when the spindle is driven with the back gear in action. The "B Reduction" gives similar data for the gears when driven through the back gear after the addition of another pair of gears, as hereafter noted, and the data referring to "C Reduction" gives the strength of the gears when driving without the back gear in action. The column headed "Strength at Tool" gives the equivalent pressure on the tool which will strain each gear to its maximum capacity. These pressures are calculated on the basis of a cutting speed of 60 ft. per minute, the maximum diameter of the work being 60 in.

The spindle speeds and horse-power curves are shown by the diagram Fig. 3. The diagram is divided horizontally into three parts referring to the A, B and C gear reductions, respectively. A 25 h. p. Crocker-Wheeler motor is used and is designed to operate on a four-wire system and the horizontal scale on the diagram shows the five different voltages which can be obtained by this method, while the vertical ordinates refer to the revolu-

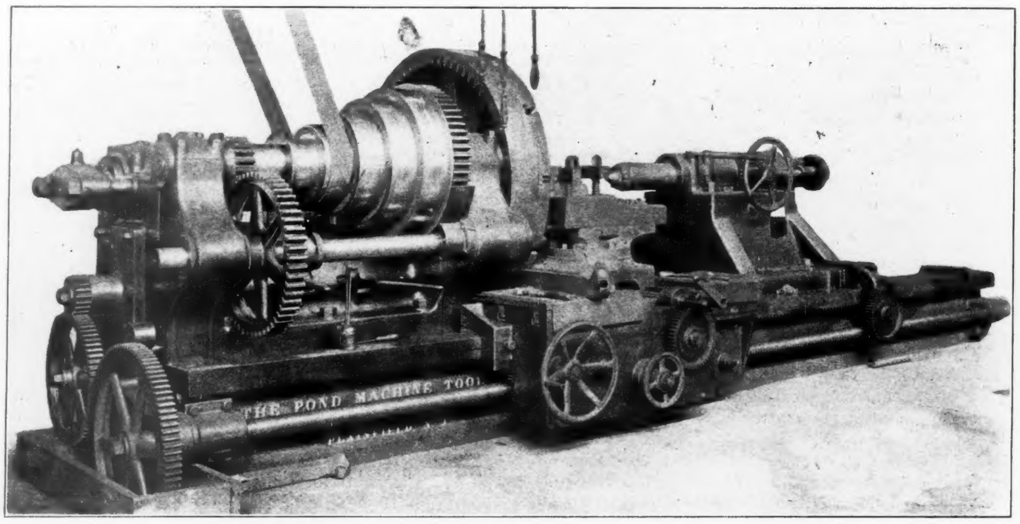
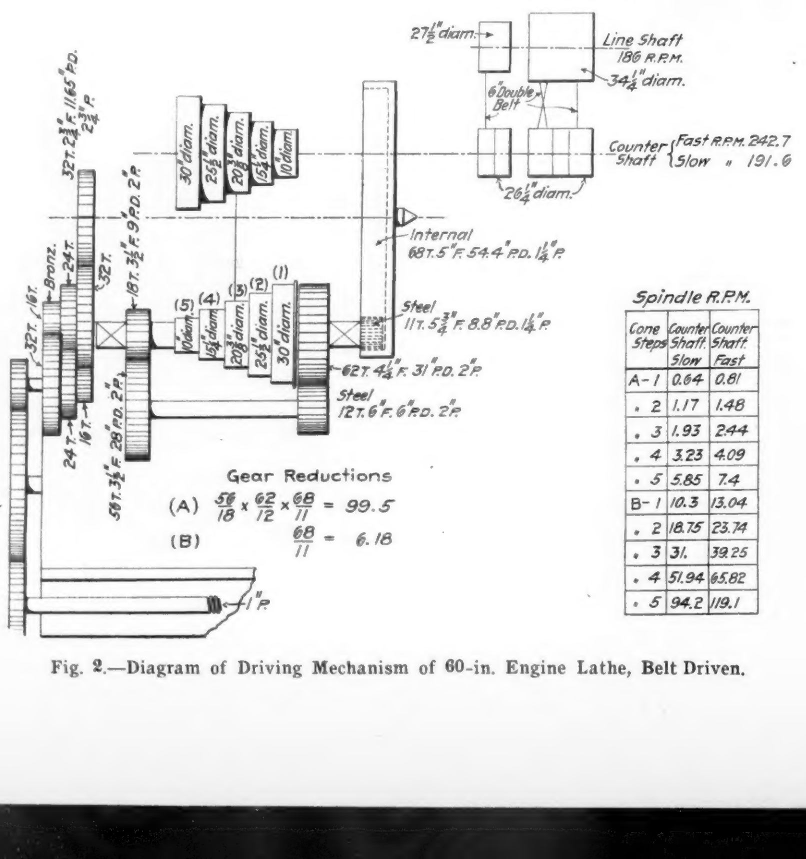


Fig. 1.—General View of 60-in. Engine Lathe, Belt Driven.



Spindle R.P.M.

Cone Steps	Counter Shaft. Slow	Counter Shaft. Fast
A-1	0.64	0.81
" 2	1.17	1.48
" 3	1.93	2.44
" 4	3.23	4.09
" 5	5.85	7.4
B-1	10.3	13.04
" 2	18.75	23.74
" 3	31.	39.25
" 4	51.94	65.82
" 5	94.2	119.1

Fig. 2.—Diagram of Driving Mechanism of 60-in. Engine Lathe, Belt Driven.

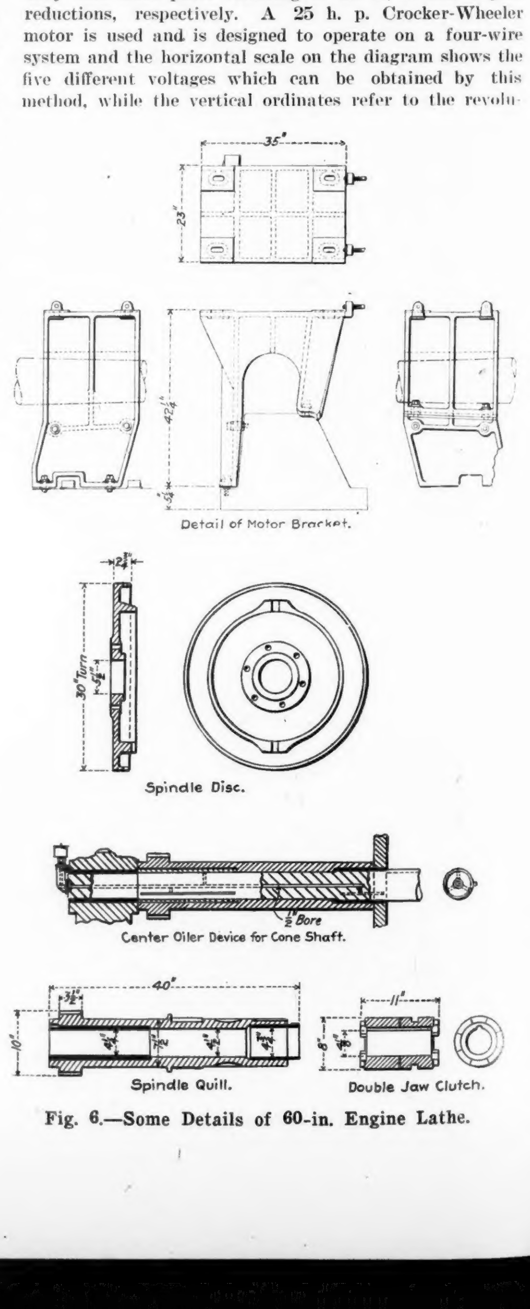


Fig. 6.—Some Details of 60-in. Engine Lathe.

tions of spindle, pressure on the tool, horse power of motor and horse power of cut for the several voltages. With the A reduction the lowest speed of the spindle is 1.066 r. p. m. and increases gradually up to 3.57 r. p. m. as the voltages at the motor terminals are increased. At the lowest speed and with a piece of work in the lathe 60 in. in diameter, it is only possible to attain a cutting speed of 16.7 ft. per minute, and the corresponding pressure at the tool post, which will strain the weakest gear to its capacity is 21,900 lbs. As the speed is gradually work, but the diagram is valuable in showing whether the cuts specified are greater or less than the capacity of the machine.

The arrangement of the motor and gears is shown by Fig. 4. By the introduction of the intermediate set of gears three initial speeds are available, making the total range from one revolution to 57½ revolutions, the motor not being speeded above its normal rating of 236 volts. The minimum speed of one revolution will make it possible to machine a piece of work 5 ft. in diameter or the

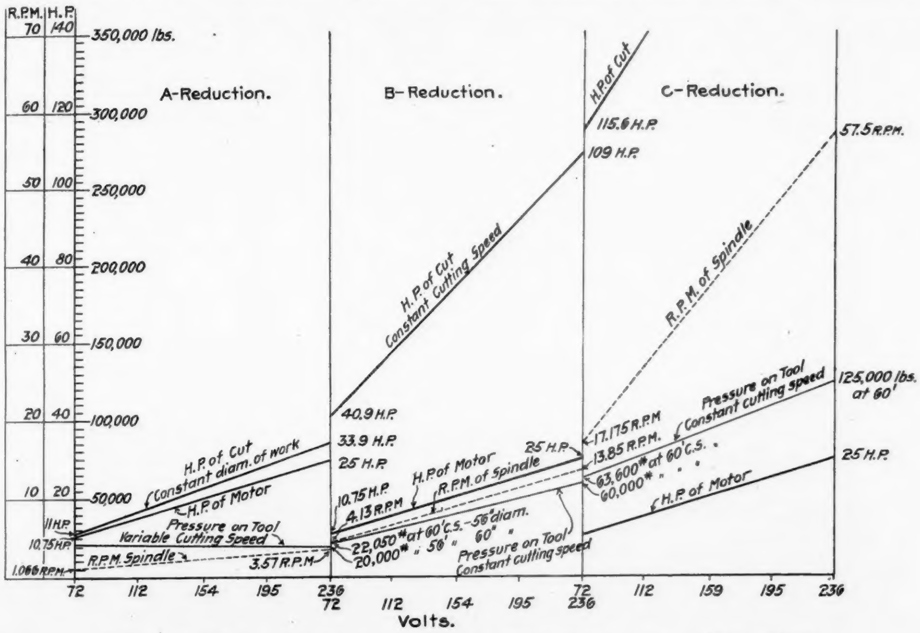


Fig. 3.—Speed and Horse Power Curves for 60-in. Engine Lathe, Motor Driven.

increased the cutting speeds also increase, but the available pressure on the tool decreases slightly owing to the fact that the permissible static stress on the gears drops with the speed. It is for this reason that the maximum pressure at the tool post, for the highest speed with the A reduction, is a trifle less than at the lowest speed. The curve marked "Horse power of Cut" is calculated from the r. p. m. of spindle and the pressure on the tool, while the horse power of motor is obtained from the known characteristics of the machine. It will be noted that at all speeds the machine is amply strong enough for the size of motor used, which is indicated by the fact that the horse-power curve of the motor drops below that of the horse-power curve of the cut.

If a higher speed than 3.57 r. p. m. is required it is necessary to throw in the B reduction. With the controller at the lowest working voltage the minimum speed of the spindle, as shown by the diagram for the B reduction, is 4.13 r. p. m. The speed gradually increases to 13.85 r. p. m. as the voltages are increased. With a piece of work in the lathe of maximum diameter, namely, 60 in., and the revolutions of the spindle 4.13, it will be seen that the corresponding cutting speed will be greater than 60 ft. per minute. Hence, when maintaining a constant cutting speed of 60 ft. per minute, it is necessary to reduce the diameter of the work to 56 in. As the speeds increase the diameter must likewise decrease. The significance of the curves for the B reduction is the same as that noted in the description of the A reduction. Similarly, the curves are given for the C reduction without the back gear in action. It will be noted that with the B and C reductions the possible horse power of the cut, as limited by the strength of the gear, is far in excess of the horse power which can be developed by the motor, hence the machine is amply strong at all points. The pressure given by the diagram should not be confused with the actual pressure which can be taken by the machine tool, but the values given by the diagram show to what extent the machine can be loaded. Other calculations, as before noted, based on cutting feeds and speeds of the material to be handled and the strength of the tool, are made in order to determine the actual conditions for each particular piece of

maximum swing of the lathe at about 16 ft. cutting speed, but slower speeds can be obtained, if desired, by dropping down to 32 volts. The maximum speed of 57½ revolutions will permit of a 45 ft. cutting speed on a 3 in. diameter.

The general arrangement of the lathe after the improvements are made is shown by Fig. 5. The motor is

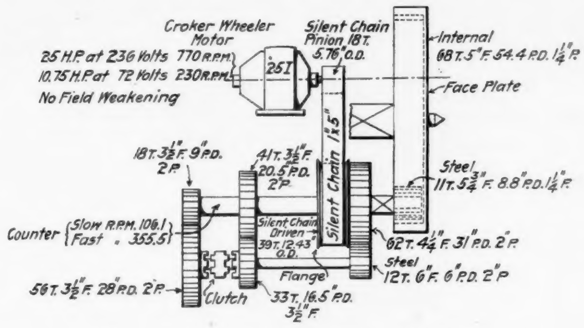
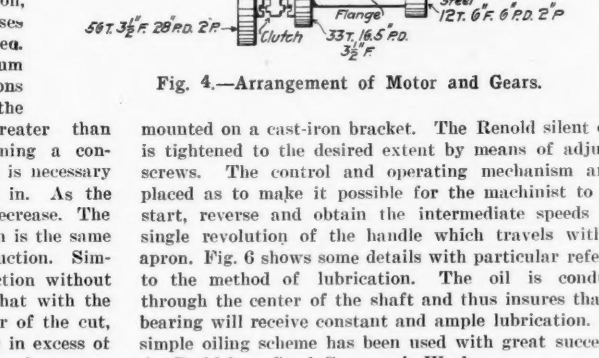


Fig. 4.—Arrangement of Motor and Gears.

mounted on a cast-iron bracket. The Renold silent chain is tightened to the desired extent by means of adjusting screws. The control and operating mechanism are so placed as to make it possible for the machinist to stop, start, reverse and obtain the intermediate speeds by a single revolution of the handle which travels with the apron. Fig. 6 shows some details with particular reference to the method of lubrication. The oil is conducted through the center of the shaft and thus insures that the bearing will receive constant and ample lubrication. This simple oiling scheme has been used with great success at the Bethlehem Steel Company's Works.



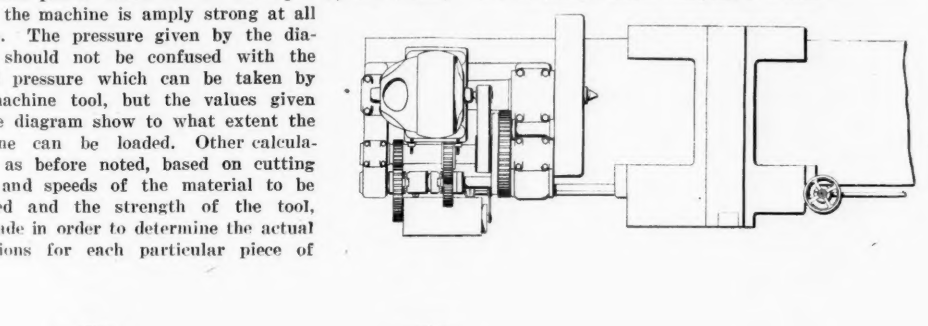


Fig. 5.—General View of 60-in. Engine Lathe After Application of Motor Drive.

Locomotive Painting.*

Painting as a whole, in these later days, is not given sufficient credit as to its merits and understanding; too much stress is given to theory, and the practical man and his experience are cast aside. It is a hard matter for one who has given years of time to the study and practice of the craft to meekly and briefly explain so much in such a short time, which it has taken years of time to learn. During the '60s, and for some years into the '70s, protection and durability of the parts was not the only requirement; beauty of finish and attractiveness was an equal essential; time and expense was not largely considered. The old locomotive painted at that time was highly decorated and ornamented, and I have known, in the painting of a passenger engine, of the expenditure of more than a hundred dollars for ornamentation alone. We would not put that on a car now. I speak of that to show that there is a great difference in the cost of painting now as compared with the '60s and '70s. In these days protection to the parts, durability of finish, speed and cheapness are required, involving some change in the processes and materials used, but the principles underlying car and locomotive painting remain the same, i. e., protection to construction and durability of finish.

In locomotive painting, I call your attention to the fact that the headlight, sandbox, steam dome, chests and cylinders and the tank, being metal, require a different formula for each. The headlight being black or Russia iron, requires a paint that will adhere to the metal, protect it from rust and not chip or scale by the contraction of the metal, which is bound to occur frequently during cold weather. I speak of black or Russia iron because it is a smooth metal or iron; consequently the paint requires a different adhesion formula than that which would be used on cast-iron, which will absorb, and give a surface which the oil can grasp. For that reason a formula is used that would give more body than oil itself. The first or priming coat must be semi-elastic. The painting of the steam chests, cylinder covers, sand-box and steam domes, being those parts known as superheated, should have semi-elastic coats throughout, with enamel or varnish finish in the formula of which little linseed oil should be used. Nothing in formula for painting these parts should be used that is liable to lose life by burning out. The surface must stand both expansion and contraction, and instead of chipping or scaling it should bake to the metal and become a part of it. Anything containing a large proportion of gum, such as varnish, if the gum used in the varnish is the proper kind of gum, not a cheap grade, will adhere to the metal and bake to it. In the painting of the tank, although of metal construction, the action of the paint is different, it being subject to cold and heat brought about by filling the tank with cold water, or by heating the water by injection of steam. Therefore a paint is required that will meet these conditions as well as resist the effects of the continual moisture produced either by water or by sweating; a paint that will prevent rust, preserve the metal, be durable and at all times present a good finish. Such a paint assuredly must be a good one, and it cannot be produced with any or every cheap material in the market.

We all know that before applying paint to castings it is first necessary to remove what may be termed a sand shale, by having the metal filed or ground with stone. On rolled metal all scale and rust must always be first removed. The metal having been thus prepared to receive the paint, the following formula will be found very acceptable for speed, finish and durability.

Priming or first coat for the superheated parts, i. e., the sandbox, dome castings, cylinder covers, steam chests, etc., use

One part Prince's Mineral, dry.
One part red lead, dry.

Mix with one part rubbing varnish, one part wearing body varnish, run it through a mill and grind fine, thin with turpentine for use. The varnishes should be mixed together before putting in the pigment.

For second coat use the same as for priming, excepting that only one-half the amount of varnish is to be used.

No. 1. Paste putty for scraping in, or plastering:

15 lbs. white lead in oil.
3 lbs. white lead, dry.
12 lbs. Gilder's whiting, dry.
½ lb. lamp black, dry.
2 lbs. Prince's Mineral, dry.
½ gallon coach japan.
1 gallon rubbing varnish.
⅛ gallon turpentine.

Mix the liquids together. Take a little bit of it and break up the keg white lead, then mix all together and grind in a mill.

No. 2. Putty for facing:

¼ gallon rubbing varnish.
⅜ gallon coach japan.
⅛ gallon turpentine.

Mix these together, then add dry white lead sufficient to make a paste putty, add ½ oz. dry lamp black for coloring, grind in mill. This No. 2 putty may be dispensed with unless it is desired to prepare a quite smooth surface. Thus by proper cleaning, proper application with brush and knife, we have brought the surface to where,

*Extracts from a paper read at the April meeting of the Northwest Railway Club, by A. J. Bishop.

with sandpaper, it can be prepared for coloring. A more perfect surface may be obtained after puttying large defects by the application of rough stuff, applying two or more coats and bringing to a smooth surface by rubbing with stone and water. When using rough stuff it is not necessary to use either the No. 1 or No. 2 putty previously mentioned. If it is desired to use rough stuff, make it by this formula:

3 parts English filler, dry N. & H.
1 part keg white lead.
2 parts rubbing varnish.
1 part coach japan.

Cut white lead with turpentine, mix japan and varnish together, then add the white lead and turpentine, and then mix in the dry English filler. After running through the mill course, thin to proper consistency for application with turpentine. The rubbing varnish herein mentioned should be a good outside rubbing varnish. In using these formula for the work mentioned I have seen very good results. To those who know the nature of the makeup of these formulæ it is needless for me to say that the enamel or varnish color coat may be applied on the third to fifth day. Lettering or ornamenting may take up an extra day and then follows the necessary time for varnishing. When the rough stuff system is used for the painting, the time to preparatory coat for color requires five to eight days. The rough stuff coating and the rubbing with stone and water may be omitted, and the formula used for quick processes. It will be found necessary to use rough stuff upon wood surfaces in order to obliterate or hide the grain of the wood, plane marks, etc. Otherwise they will show after the gloss coats are applied. In all cases where rough stuff is used, two or more coats are required. The painting of the tank may successfully be accomplished by these formulæ.

Priming composed of two parts of boiled linseed oil, two parts turpentine, made stiff with one part Prince's mineral dry, one part red lead dry and ground fine, thinning for use with liquids of same proportions, care being taken to have this coat well brushed out.

Second coat: One part Prince's mineral dry, one part red lead dry, ground in two parts boiled linseed oil and three parts turpentine, thinned in same for use, adding one-half pint japan to 8 lbs. of the ground paint, applied freely with the brush and evenly brushed out.

The object in cutting the white lead with turpentine, when using rough stuff, is to have the lead thoroughly cut and in a fine state, to prevent lumping. It is liable to lump if the lead and the English filler are all thrown together. Many painters apply the paint evenly, but leave it so; they do not brush it out to a thin coat as it should be. Paint to dry correctly, should be applied evenly and well brushed out so as to leave a thin coat on the surface. The greatest difficulty we have from cracking and peeling is on account of the undercoats not being dry, and another coat applied, forming skin or scum on the outside, thus shutting off the atmosphere and preventing it from penetrating to the body surface, leaving it still wet underneath. This again painted over with a second coat, will surely cause cracking.

Putty is composed of 20 lbs. dry white lead, 12½ lbs. dry English filler, 10 lbs. keg white lead, 1 lb. dry lamp black, equal parts of coach japan and inside rubbing varnish, well mixed and thoroughly pounded. Here again we must determine whether or not rough stuff shall be used, or the knifing surfacer; in either case the above formulæ answer. Should rough stuff be used it is best to follow it with a coating known as the guide coat. This is applied only to aid the men while rubbing so that they may see when a surface is being produced. On a perfect surface none of the guide coat remains after rubbing. Much time is saved by its use, and the rubbing can be done with common labor. To mix a guide coat there are various formulæ. A good one is to use two parts dry English filler, two parts dry white lead mixed with equal parts slow rubbing varnish and coach japan ground medium fine, thinned for use with turpentine. This formula can be greatly cheapened by using gasoline in lieu of turpentine where no objection can be raised owing to its inflammable nature, much depending upon the surroundings when used. Having now a rubbed surface preparatory to applying color, the color coat can be applied after a light sandpapering, which is necessary to remove any grit that may be left upon the surface after having been rubbed with the stone, using color in which one part is varnish, two parts japan, thinned for use with turpentine. This does not apply to all colors. There are colors which require a varnish mixer, there are other colors that will not stand a varnish mixer and which should be mixed with oil. The object in using varnish for color is to give a stronger binder than japan or turpentine will give, where oil cannot be used in sufficient quantity to make a strong binder. Having applied a coat of this color, more for the purpose of obtaining covering body than for anything else, a varnish color coat or enamel may be applied, then lettered and varnished: this, for first-class work, requiring from 15 to 18 days for completion. By leaving out the rough stuff, the guide coat and the rubbing, using the knife process and applying formula No. 1 previously mentioned, either one or two coats, sandpapered to a finish, colored and varnished, time may be greatly shortened. However, this is at a sacrifice to fine appearance, not really essential for durability, or for locomotive painting generally. In the removal of scale and rust from metal various systems are in use. Where possible, the sandblast is undoubtedly the best, provided that a sand can be obtained that is flinty, containing good grit and wearing qualities; otherwise a piece of grindstone and water, with hours of muscular labor. There are many systems of locomotive painting which are apparently satisfactory, but there is no system prepared by the manufacturer of paints and varnish or home-made products, in which the judgment of the experienced is not at all times taxed.

For the front end, or smoke arch, of a locomotive, a paint is required that is composed of liquid and pigment that is adhesive and heat-resisting; one that will stand a great amount of heat before burning. This is a matter that has been troubling every one connected with handling or constructing locomotives, and has recently received considerable attention. In my judgment, the best substance for this work is graphite, of which silica forms a part. This graphite, I believe, will resist the heat, protect the metal from rust and produce a good appearance. Were I now doing locomotive work, I should like to try upon a front end, after it had been cleaned free from rust and scale, the following: Coat the metal with a mixture of equal parts of wearing body varnish and boiled linseed oil. Allow to stand drying until it has become tacky, and then rub over the surface with dry graphite, either of the Superior or the Wisconsin grade. While this would not make a black finish but be a little on the gray order, it would look better than stove polish. I mention this from the fact that I have recently seen engines that were blackened on the front end with stove polish. I do not think it looks quite as well as plain black.

The difference in car and locomotive painting from that of house painting is in the elimination of linseed oil from the pigment, and the substitution of japan and turpentine as a vehicle. In house painting the durability of the paint and the protection it affords to the surface coated with it depends mainly on the linseed oil and the pigment, while in coach and locomotive painting both the durability of the paint and the protection of the surface is mainly due to the varnish with which the painting is covered. A varnish, therefore, should be of the best quality obtainable. As in the construction of a building, if the foundation is faulty, the whole superstructure erected upon it may give way, so in painting, if the material used in the foundation coats are improperly prepared and applied, or ample time is not given for drying of each coat before the next is applied, then all the varnish that may be applied to cover it will not save it from disintegration; on the other hand, if material and application in foundation coats are good and an inferior grade of varnish be used, it will afford no protection.

The Shantung Railroad.

At a meeting of the Railroad Science Society in Berlin last May the Manager of the Shantung Railroad, which a German company is building in the Chinese province of that name, said that this province with an area of 65,000 square miles has more than 38,000,000 inhabitants—that is, half the population of the United States by the last census in an area less than that of the State of Missouri—although there is a thinly peopled mountainous district in the middle of the province. The railroad, begun in 1899, but interrupted by the insurrection of the next year, was opened from Chifu, the port in the northeast of the province, to the great trade city, Tsingchonfu, 150 miles, April 12 last, and is to be completed next September 38 miles further to Choutsun, the great silk market of the province. Construction in the loess formation was found to involve special difficulties. Many bridges, of an aggregate length of 23,446 ft. have been or are to be built, with some difficult foundations. All materials come from Germany with the exception of timber, stone and quicklime.

The Shantung Railroad Co. advertises in Germany for three experienced locomotive enginemen to go to China and serve with freight locomotives and supervise the Chinese employees. They must be sound in health, perfectly temperate, conscientious, of quiet disposition and not involved in debt; preferably unmarried. The contract is probationary for one year. One room for lodging will be provided for unmarried and two for married men without children. The pay will be $952 (4,000 marks) for the first year, with an allowance for equipment of $72 for the unmarried and $120 for the married. The company pays the passage out, third-class, and allows besides traveling expenses to the amount of $48 and $72 for the unmarried and married, respectively; and pays the cost of accident insurance for 6,000 marks.

The Schoen Solid Forged and Rolled Steel Wheel.

A new and interesting process of making wheels has recently been perfected by Charles T. Schoen which offers a possible solution for the car wheel question for the high capacity car. By it a solid steel wheel, forged and rolled, can be produced which has all of the advantages and none of the objections to the steel-tired wheel, and at the same time costs comparatively little more than the cast-iron wheel.

The process used in making these wheels consists in casting a circular ingot of steel 24 in. in diameter which is forged under an hydraulic press of special design. This forging perfects the hub and in reducing the thickness of the web increases the diameter of the blank to about 28 in. The blank is then passed to the rolling mill, where it is worked between six rolls, to the finished diameter of 33 in. From the rolling mill it is passed to a powerful hydraulic press, where the wheel is coned or dished so as to bring the edge of the rim or tire into proper alinement with the hub, and at the same time face up the hub. Fig. 1 shows the double acting forging press used in forging the blanks from the ingot. It can exert a pressure of 5,000 tons and stands 45 ft. high with the bottom 18 ft. below the floor line. The rolling mill, Fig. 2, is a massive machine and occupies a floor space 22 ft. x 40 ft. A pair of 1,000 h.p. reversible engines are required to drive the rolls and three electric motors to drive the six feed rolls which are arranged to operate either singly or in combination. The motors cut off automatically when the proper diameter and thickness of the wheel has been reached.

The appearance and shape of the wheel is shown in Figs. 3 and 4, which show a finished wheel and sections

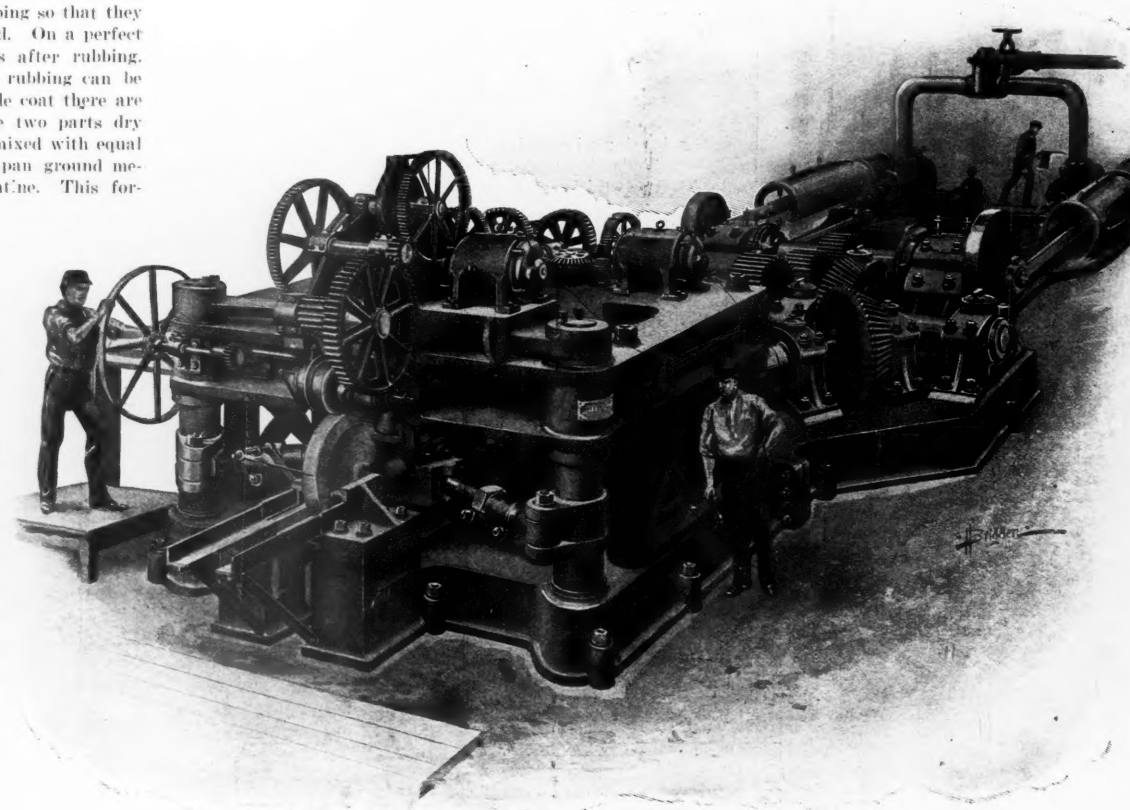


Fig. 2.—Steel Wheel Rolling Mill.

cut from it. The contour of the tread and flange are perfect and the surface of the whole wheel is finished smooth and free from scale or roughness of any kind. The web is formed straight and extends from the center of the hub to the center of the rim. Much of the weight is in the thick rim which allows the tread to be worn or turned down 1¾ in. before the wheel must be scrapped. This is much more than the usual limit with steel tires. These wheels weigh between 600 lbs. and 625 lbs. With one set of forging presses and rolls the time of finishing from the ingot is about four minutes and the process is carried on with one heat. The steel

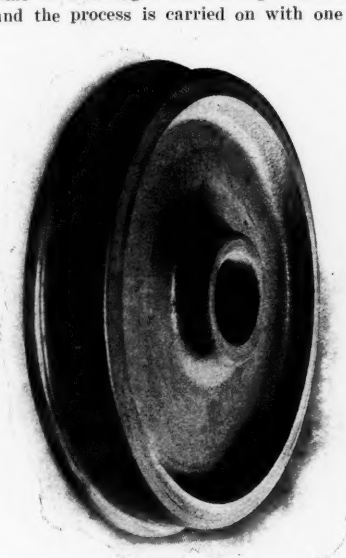


Fig. 3.—Solid Forged and Rolled Steel Wheel.

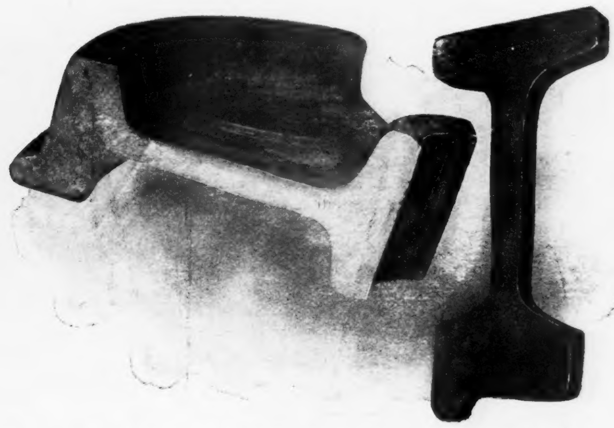


Fig. 4.—Sections of Solid Forged and Rolled Steel Wheel.

used has the same chemical and physical properties as that used in making the best quality of steel tires and the method of working the metal is almost the same so that the strength and wearing qualities of the finished wheel are quite equal to the steel tire.

A solid steel wheel made by such a process as this would seem to be the ideal wheel, combining the strength of the steel-tired wheel with the simplicity of the cast-iron wheel. There are no separate parts to work loose and the method of forging insures a homogeneous structure throughout the entire wheel. The metal has an elongation of from 12 to 15 per cent., and a tensile strength four times that of cast-iron. The cost of production over cast-iron wheels is but little more than the cost of converting pig iron into steel since there is no expensive machine work to be done and no loss due to defective material. The increased mileage and safety and the decreased weight of the forged wheel more than offset the difference in first cost. It can be turned down thinner than the steel-tired wheel since the tire is an integral part of the wheel. A large proportion of failures of cast-iron wheels under high capacity cars has been due to the excessive heat developed by long continued applications of the brakes. This has a tendency to cause unequal expansion on the rim and consequent internal strains which separate the radial crystals of chilled metal and start hidden cracks on the inside. These gradually work out to the surface through the constant pounding over frogs and crossings and uneven joints until the defect becomes noticeable or a flange breaks out. To obtain the strength of metal necessary for modern wheels a high grade of charcoal pig is used, and to preserve the wearing qualities an excessive amount of manganese is added which tends to further crystallize the iron on the tread and lay the foundation for future trouble. With a homogeneous steel tread not chilled there are no crystals to separate under the action of heat, and the trouble from this source is not so pronounced. With a steel-tired wheel, however, there is a chance for the tire to expand and hammer itself out of shape while loose. There is no such danger with the solid steel wheel.

The first wheels made by this process were turned out some time ago from the plant erected at Bethlehem, Pa., where the experiments were carried on. They are now in use under the heaviest cars in various parts of the country with excellent results so far. The Schoen Steel Wheel Co. has been formed to put these wheels on the market.

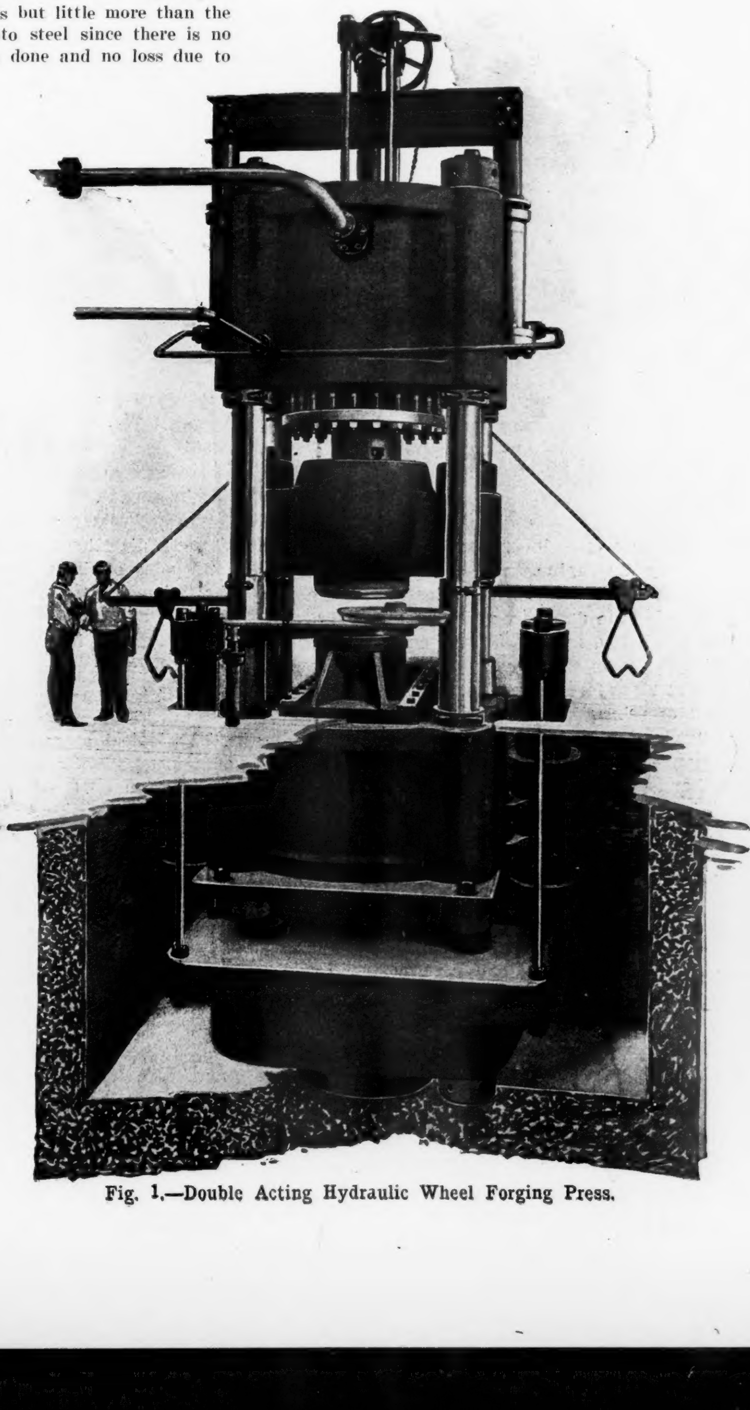


Fig. 1.—Double Acting Hydraulic Wheel Forging Press.

Railroads of Algeria.

The French colony of Algeria has 1,804 miles of railroad and Tunis 424 miles. Algeria has been under French rule 60 years and more, and has long had railroads. The traffic developed, however, is light, averaging for Algeria and Tunis together in the year 1900 a movement of 83½ passengers and 95 tons of freight each way daily over the whole system, which may be compared with the movement of 99 passengers and 718 tons freight in this country for the year ending six months later. The passenger movement in this country south of the Potomac and Ohio and west of the Missouri was lighter than in Algeria however; but the freight movement was many times as large, even in our districts of lightest traffic. The Algerian railroads earned $2,728 gross and $600 net per mile, and a trifle more than 1 per cent. on their cost. The average rates were 1.513 cents per passenger mile and 2.211 cents per ton-mile.

Railroad Statistics to June 30, 1902.

The Interstate Commerce Commission has issued an abstract of the statistician's report of the operations of the railroads of the country for the fiscal year that ended June 30, 1902. The preliminary income report for the 12 months here reported was issued last December and appeared in the *Railroad Gazette* of December 5, page 922. The principal items in the abstract now issued are given in the table below, in which we include the figures for the preceding two years, taken from the similar statement published in the *Railroad Gazette* of Sept. 5, 1902, in which were also given the totals for 1899.

Railroad Statistics for Year Ending June 30.

	1902.	1901.	1900.
Miles of railroad completed...	202,472	197,237	193,346
Increase in 12 months........	5,234	3,892	4,051
Miles of road operated.......	200,155	195,571	192,556
Number of corporations......	2,037	2,057	2,023
Number in hands of receivers..	27	45	52
Mileage in hands of receivers..	1,475	2,497	4,178
Locomotives	41,228	39,584	37,663
Cars owned, passenger........	36,991	35,969	34,713
Cars owned, freight...........	1,546,132	1,464,328	1,365,531
Cars owned, total............	1,640,220	1,550,833	1,450,838
Cars and eng. with pow. br'ks.	1,306,849	1,164,048	1,005,729
Do. with automatic couplers...	1,648,535	1,549,840	1,404,132
Employees	1,189,315	1,071,169	1,017,653
Employees per 100 miles road.	594	548	529
Capital stock, com., millions...	$4,722.1	$4,475.4	$4,522.3
Capital stock, pref., millions...	1,302.1	1,331.2	1,323.3
Capital stock, total, millions..	6,024.2	5,806.6	5,845.6
Funded debt, millions........	6,110.0	5,881.6	5,645.5
Current liabilities, millions....	648.2	620.4	594.8
Total stock and funded debt, millions	12,134.2	11,688.2	11,491.0
Total stock and funded debt per mile of road...........	62,301.0	61,528.0	59,676.0
Dividends paid, millions......	185.4	156.7	139.6
P. c. stock rec'v'g no dividend.	44.6	48.7	54.3
P. c. mtg. bonds rec'v'g no int.	3.5	3.3	5.4
Av. div'd on div'd-pay'g stock.	5.5	5.2	5.2
Gross earnings, year passenger, millions	$393.0	$351.4	$323.7
Gross earnings, year, freight, millions	1,207.2	1,118.5	1,049.3
Gross earnings, year, total, inc. misc., millions..........	1,726.4	1,588.5	1,487.0
Average of same per mile.....	8,625.0	8,123.0	7,722.0
Operating expenses, millions...	1,116.2	1,030.4	961.4
Net earnings, millions........	610.1	558.1	525.6
Other income, millions.......	196.3	179.7	162.9
Net income, millions.........	806.5	737.9	688.5
Fixed charges, etc., millions...	526.2	496.4	461.2
Net available for div., millions.	280.3	241.5	227.3
Dividends paid, millions......	185.4	156.7	139.6
Passengers carried, millions...	649.9	607.3	576.9
Passengers 1 mile, millions...	19,690.0	17,353.6	16,039.0
Freight carried, million tons..	1,200.3	1,089.2	1,101.7
Same, one mile..............	157,289.4	147,077.1	141,590.2
Av. rate per ton-mile (mills)..	7.6	7.5	7.3
Av. pass. fare per mile (cts.)..	2.0	2.0	2.0
Employees killed	2,969	2,675	2,550
Employees injured	50,524	41,142	39,643
Passengers killed	345	282	249
Passengers injured	6,683	4,988	4,128
Other persons killed.........	5,274	5,498	5,066
Other persons injured........	7,455	7,209	6,549
Total killed	8,588	8,455	7,865
Total injured	64,662	53,339	50,320

The report shows the density of equipment; 206 locomotives and 8,195 cars are used per 1,000 miles of line, 62,985 passengers were carried and 1,908,310 passenger miles accomplished per passenger locomotive, and 50,874 tons of freight were carried and 6,666,499 ton miles accomplished for freight locomotive. There were substantial increases in density of traffic per mile of line, both in passenger and in freight.

A new feature of the full report will be summaries showing tractive power and other data for locomotives, classified as single-expansion, four-cylinder compound, and two-cylinder compound locomotives, and others showing the classification of freight cars on the basis of capacity.

The average revenue per passenger per mile for the year ending June 30, 1902, was 1.986 cents. For the preceding year it was 2.013 cents. An increase in earnings per train mile appears for both passenger and freight trains, and the average cost of running a train one mile also increased. The percentage of operating expenses to earnings was 64.66 per cent. The amount paid in salaries and wages to employees during the year was $676,028,592, equivalent to 60.56 per cent. of the operating expenses, and 39.16 per cent. of gross earnings.

In "deductions from income" (fixed charges) are embraced the following items: Interest accrued on funded debt, $274,421,855; interest on current liabilities, $7,717,103; rents paid for lease of road, $111,697,122; taxes, $54,465,437; permanent improvements charged to income account, $34,712,968; other deductions, $42,637,299.

The report includes an analysis of taxes, by States and Territories, showing the basis of payments according to the various laws under which railroads are taxed.

In the chapter on accidents it appears that the casualties to employees resulting from coupling and uncoupling cars were, killed, 167; injured, 2,864. The corresponding figures for the year 1901 were, killed, 198; injured, 2,768. The number of passengers killed in collisions and derailments was 170; and 3,429 injured. The summaries giving the ratio of casualties show that one out of every 401 employees was killed and one out of every 24 was injured. Of trainmen, one was killed for every 135 employed and one was injured for every 10 employed; and 57,072,283 passenger miles were accomplished for each passenger killed and 2,946,272 passenger miles for each passenger injured.

RAILROAD GAZETTE

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CONTRIBUTIONS.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

The retirement of Mr. F. W. Webb, the Chief Mechanical Engineer of the London & North Western is a matter of equal interest to American and British engineers. Those who have followed the development of the modern locomotive will not fail to give Mr. Webb proper credit for the work which he has done towards advancing the art of locomotive building. A half century or more ago when he first entered the service of the London & North Western, the locomotive was a comparatively crude affair and the designer was chiefly concerned with producing a machine that would *move* rather than one that would do a maximum amount of work for a maximum expenditure of fuel. To Mr. Webb is due the credit of first using in England a four-cylinder balanced compound and this type was a development of his earlier design of a three-cylinder compound. A brief review of his life and work by Mr. Rous-Marten is given elsewhere in these pages. The name of Mr. Webb will always be associated with the history of the locomotive and he will hold a place of honor with the score or more of others whose skill and ingenuity has simplified the otherwise difficult problems of modern railroading.

The new process of making car wheels, described elsewhere in this issue, concerns the old question of the cast iron wheel vs. the steel-tired wheel. It is not necessary to rehearse the arguments in favor of one or the other. There are inherent defects in the cast iron wheel, due to the nature of the material used; there are serious though different objections to the steel tired wheel. When the cast iron wheel was first introduced its safety was doubted, yet perhaps no other one detail of car construction has had such a bearing on the cost of transportation. Its use has saved and made millions for the railroads and justified every claim made for it that it was safe and cheap. Its makers have met every increase in the service to which it has been put with an increase in quality of metal, better distribution of material and only slight increase in weight, and to them credit is due. But there are limits beyond which they cannot go. If the wheel for an 80,000-lb. car fails under a 100,000-lb. car, there is only one way to get around the difficulty; to increase the unit strength of the metal, because guard rail and frog gages limit the size and shape of the tread and flanges where the failures occur. Cast iron wheels are being made and are running in service under the heaviest cars with few failures, but there is an element of uncertainty about them. The situation to-day is that the cast iron car wheel has about reached its maximum strength, and any further increase either in the load or braking pressures will necessitate the use of some other material, stronger and perhaps more costly. The one argument which we have dwelt upon in discussing the merits of the chilled wheel has been, that beyond any doubt it is economical. Taking into consideration the first cost, length of service and liability of failure under conditions of service which prevailed up to the introduction of the 100,000-lb. car, the cast iron wheel costs less per ton mile moved than the steel tired wheel. If, however, the first cost of the steel tired wheel could be reduced, say one-half, the argument fails to hold true, for this factor is the most important of the three. It is claimed for the new process of making wheels that by it a solid steel wheel can be produced which costs half the price of a steel tired wheel, has the same composition and wearing qualities, possesses all of its advantages and none of its defects. Here then is a wheel, lighter and stronger than the cast iron wheel, more reliable under heavy loads and excessive brake applications, with a tread which may be worn down or turned down until it is used up in revenue paying service, with no danger of cracked hubs or broken tires, and which costs but a third more than the iron wheel and only half that of a steel tired wheel. If these claims are substantiated here is a possible solution of the wheel problem. So far as the expensive steel tired wheel is concerned, it is out of the question for freight service, generally, because it costs more than it is worth; but of this new solid steel wheel, that may be, as Kipling says, another story.

The Work of Enginemen and Firemen.

The demands made by trainmen for extra pay on double-headed trains, with the avowed purpose of preventing such economy in hauling freight, is so plainly an undertaking to increase the cost of living that every corporation so beset has a plain duty which should not be shirked. On the other hand, the demands made by locomotive enginemen and firemen for pay based on the amount of work done and on the skill, discipline and intelligence required for running a modern big locomotive deserve careful consideration. It is evident that most of the conditions of work by the men in the cab have been radically changed by the increase in the size of locomotives, the speed required, and the use of the air brake, steam heating, block signals and interlocking. As to this there has been much argument based on misinformation, and we are fortunate in having the results of a study of the changed conditions made by an expert who is thorough, competent and judicial.

As to the Engineman: There has been a slight increase in his labor on account of the number of parts of the engine to be oiled and looked after; but as the time consumed in this is such a small percentage of his total time, it is hardly worth mentioning. On the other hand, many of the modern attachments, such as self-oilers, self-starting injectors, etc., are labor savers. His responsibility has been increased in that he hauls larger trains and accidents are much more disastrous than with smaller trains. On the other hand, his liability to accidents has been materially reduced by the introduction of air brakes, block signals, increased double track, more substantial and better designed equipment, etc.

The air brake has not increased his labor, but it has lessened it, as stopping the train and in switching the engine and the train, or such part of the train as he may be handling, the work is done by a slight movement of the hand, where formerly it was frequently necessary to use the reverse lever, and in switching, the reverse lever was used almost entirely for stopping the engine.

The increased double track has lessened his responsibility under the duplicate order system. He takes sidings much less frequently, and on some divisions occupies the main track over almost the entire division. The stops formerly made at junction points and railroad crossings have been largely eliminated by the introduction of interlocking. The terminal improvements enable him to pull his train into the yard, cut off and go directly to the engine house, whereas formerly it was often necessary to do more or less switching.

Formerly he was required to do practically all the running repairs to the engine in the way of filing and keying up rod brasses, setting up wedges, adjusting cylinder packing, facing valves, etc. Later, he was relieved of the greater part of the work, but was required to pack the stuffing boxes and keep the rods keyed up. With the introduction of metallic packing for stuffing boxes and the employment of more men in the enginehouse, he was finally relieved of all this work, as well as that of cleaning and filling the headlights, so that now he has practically no work to do on the engine before leaving or after arriving from a trip. All that is required of him is to oil the engine, look it over and see that it is in proper shape for service, and at the end of the trip to make a written report of work necessary to be done on the engine to keep it in running order.

The increase in the speed of trains and the facilities furnished for their movement, the lengthening out of operating divisions, all enable him to put in his time much more effectively than formerly, increasing the amount earned per month correspondingly.

Statistics of personal injuries to employees show that he occupies the safest position in the train service. His cab has been made much more comfortable, while the erection of Y. M. C. A. buildings, bunk houses, etc., have added to his comfort while off duty. The establishment of hospitals provides for his care and skilful treatment in the event of sickness or injury; the institution of savings funds, insurance, relief association benefits, all tend to make his future more assured, while the greater consideration and forbearance in the treatment accorded him by his superior officers in the administration of discipline have made his occupation much more agreeable.

As to the Fireman: All that has been said relative to the engineman applies to the fireman, except that the amount of fuel to be shoveled has been increased by the introduction of larger engines. He has been relieved from wiping and scouring the engine, from assisting in its repair, and from having to be a "fag" to the engineman; has risen to a more independent position, while his term of apprenticeship has been materially reduced.

With the introduction of the large engine, there has been some increase in the amount of fuel to be shoveled. A competent man rode engines for many trips and, using a stop-watch, took the time occupied in charging the fire-box, counting from the time the operation was begun until the fireman had returned to his seat. The surprising result of these observations was that on some engines this occupied only 10 per cent. of his time, while on the large engines it occupied no more than 19 per cent., and, further, that his labor in this respect was quite as much affected by grades as by the size of his engine, i. e., a small engine on a high grade road might consume as much fuel as a large engine on a low grade road. It is interesting in this connection to find that on the Atchison, Topeka & Santa Fe, in California, where oil burners are used, the firemen repudiate the idea that the amount of coal shoveled has anything to do with fixing their wage. However, so long as the man is not overtired at the end of his run, the varying degree of intensity of his labor does not seem a matter of importance.

The fact seems to be plain that the present day work of the men in the cabs of big engines and those running at high speeds is of a superior sort compared with the work of a few years ago. The physical demands are probably, on the whole, lessened, while the market for brains and morals is broadened. They earn more and they get more, not because they work harder, but because their calling is more dignified and responsible than it used to be; because greater vigilance needs a higher type, and because discipline, strict obedience to block signals and to all orders require moral qualities that are worth high pay. The brotherhoods to which these men belong have, much more than other trade unions, a conception of their dignity. Following Mr. Arthur's inspiration, both enginemen and firemen have made the educational and insurance features of their organizations primary and important. They have worked to develop sobriety and character; and yet, in dickering and sometimes in dictation they cling to many of the leveling tendencies of the others. Starting with the theory that all men are born free and equal, they deny the freedom and insist upon an equality long after they have outgrown it.

The Steaming Capacity of Locomotives.

The logical expression for the steaming capacity of a locomotive is the ratio between the maximum evaporation of the boiler in pounds per hour and the weight of water used by the cylinders in the same unit of time. For example, if 1,000 horse-power is continuously developed by the cylinders of an engine, and their efficiency is such that steam is drawn from the boiler at the rate of 26 lbs. per horse-power per hour, then the total evaporation of the boiler must be at the rate of $1{,}000 \times 26 = 26{,}000$ lbs. per hour. If the boiler has 2,500 sq. ft. of heating surface and it be assumed that each square foot of heating surface is capable of evaporating 15 lbs. of water per hour, then the maximum capacity of the boiler is $15 \times 2{,}500 = 37{,}500$ lbs. per hour. The steaming capacity under those conditions is $\frac{37{,}500}{26{,}000} = 1.44$. In other words, the boiler can evaporate 44 per cent. more water than is required by the cylinders. Evidently, but two methods are

available for increasing the value of the above ratio, namely: increase the size or efficiency of the boiler or improve the efficiency of the cylinders so that less than 26 lbs. of water are used per horse-power per hour. If for instance, the cylinders be compound or superheated steam be used, the steam consumption might be reduced to 20 lbs. per horse-power per hour and hence the demand on the boiler would be reduced to 20x1,000=20,000 lbs. per hour. The steaming capacity would, in turn, be increased to $\frac{37,500}{20,000}=$ 1.88. Again if the use of a more efficient draft arrangement, or a better grade of coal, etc., increased the evaporative power of a square foot of heating surface to 19 lbs. per hour, then the maximum capacity of the boiler would be 19x2,500=47,500 lbs. per hour and the steaming capacity with simple cylinders would be increased to $\frac{47,500}{26,000}=1.83$. A steaming capacity of 1.83 could also be obtained by enlarging the boiler to 3,166 sq. ft. and retaining a rate of evaporation of 15 lbs. These fundamental conceptions are given in order to make clear the basis of the calculations which are to follow. But before proceeding, it may be well to review briefly some of the methods which have been proposed for comparing the steaming capacities of different locomotives.

At the last convention of the Master Mechanics, Mr. A. M. Waitt suggested the ratio of weight on drivers to heating surface. While it is true, that the weight on drivers is proportional to the power developed by the cylinders, and the heating surface is a measure of the capacity of the boiler, nevertheless, the ratio of the two does not give a true measure of the steaming capacity of locomotives in different classes of service. An engine designed for slow speed will not need as large a boiler as one designed for high speed service, yet the weight on drivers in both cases may be the same. Compound cylinders will use less steam per unit of work than simple cylinders, a factor which is not included in the ratio.

The following is quoted from a report to the last Master Mechanics convention by Mr. F. F. Gaines: "As the boiler must furnish a certain amount of power or an amount of energy sufficient to perform a certain amount of work in a given time, it becomes apparent that the real basis from which the amount of heating surface should be computed is the maximum power, and that the total heating surface of any boiler is the product of a constant times the maximum power demanded by the service." The maximum power is calculated from the known cylinder dimensions at a speed equal to as many miles an hour as there are inches in the diameter of the drivers. This method makes no allowance for the relative cylinder efficiencies of simple and compound locomotives, but in other respects it gives correct results. The calculations are, however, somewhat laborious and the correct determination of the mean effective pressure at the high speeds is difficult and uncertain.

Another method suggested by Mr. G. R. Henderson and adopted at the 1897 convention of the Master Mechanics, is the ratio of heating surface to cylinder volume. This is open to objection inasmuch as the power is not necessarily proportional to the cylinder volume but depends also on the initial steam pressure.

Many other ratios and formulae have been suggested by writers to the technical papers, all of whom have, without exception, entered into difficult mathematical computations based on cylinder proportions, and per cents. of cut off. The most complete investigation of this character was published by Mr. Lawford H. Fry in the *American Engineer*, October, 1902, from which he concludes that the proper measure of steaming capacity is expressed by the product of the maximum tractive effort and the driving wheel diameter divided by the heating surface.

The power developed by the cylinders of a locomotive is proportional to the total train resistance and the speed at which the train is hauled. When the engine and train are moving at a uniform speed the drawbar pull behind the engine exactly balances the total resistance of the train and the horse-power developed at the drawbar is expressed by $.00266 \times L \times R \times V$ in which L is the trainload in tons (including tender), R is the train resistance in pounds per ton and V is the speed in miles per hour. On a straight and level track (which will be taken as the basis for all comparisons) the value of R as given by the *Engineering News* formula is $\frac{V}{4}+2$ for all speeds above 10 miles an hour. This value of R can be substituted in the above expression and the drawbar horse-power computed for any given train load at any speed. The actual power developed by the cylinders will be somewhat greater than that available at the drawbar owing to losses in the mechanism of the engine and to the power expended in overcoming head end air resistance and rolling friction. It will be sufficiently accurate for the purpose at hand if it be assumed that 60 per cent. of the total cylinder horse-power appears at the drawbar. This value will vary, of course, with the type of engine, but for speeds above 40 miles an hour it is approximately correct. Let it be further assumed that the steam consumption of simple engines is 26 lbs. of water per horse-power per hour and that of compound engines, 20 lbs. The total amount of steam required by the cylinders will be given by the product of the drawbar horse-power $\times \frac{10}{7} \times$ the steam consumption. For simple engines this will be:

$$\frac{10}{7} \times \left[.00266 \times L \times \left(\frac{V}{4}+2\right) \times V \right] \times 26$$

which reduces to:

$$.247 \times L \times V \times (V+8) \quad \ldots\ldots (1)$$

and for compound engines:

$$.19 \times L \times V \times (V+8) \quad \ldots\ldots (2)$$

The maximum evaporation of the boiler will be represented by the product of the total heating surface (H) and the maximum rate of evaporation per square foot of heating surface per hour (15 lbs.) and the steaming capacity for simple engines will be as follows:

$$S \text{ (steaming capacity)} = \frac{H \times 15}{.0247 \times L \times V \times (V+8)}$$

$$S = \frac{607\ H}{L \times V \times (V+8)} \quad \ldots\ldots (3$$

For compound engines:

$$S \text{ (steaming capacity)} = \frac{H \times 15}{.019 \times L \times V \times (V+8)}$$

$$S = \frac{789\ H}{L \times V \times (V+8)} \quad \ldots\ldots (4)$$

The above formulas can be used in calculating the heating surface in a locomotive boiler when the train load and speed are known—giving the proper value to the steaming capacity. For example, assume that it be required to estimate the amount of heating surface in the boiler of a simple locomotive so that with a trainload of 700 tons, including tender, and a sustained speed of 50 miles an hour, the steaming capacity is unity. Substituting the values for L, V and S in equation (3) gives:

$$1 = \frac{607\ H}{700 \times 50 \times 58}$$

from which

$$H = 3,320 \text{ sq. ft.}$$

This result is interesting in view of the fact that one of the Central-Atlantic type engines of the Michigan Central having 3,505 sq. ft. of heating surface hauled a train of about 650 tons, including the tender, from Bridgeburg to St. Thomas, a distance of 118.2 miles at a speed of 55.8 miles an hour, the conditions being such that the boiler was taxed to about its greatest capacity, and hence the steaming capacity was unity. The load in this case was about 8 per cent. less and the speed 10 per cent. more than the assumptions of the above problem.

In order to arrive at a basis for comparing the steaming capacities of different locomotives, it will be necessary to make equations (3) and (4) more general in form. If the starting resistance of a train is 15 lbs. per ton, then the maximum load that a locomotive can start by a steady pull on a straight and level track is $\frac{T}{15}$ where T is the maximum tractive effort in lbs. Assuming that the cylinders are correctly proportioned to the weight on drivers it will usually be possible to obtain a maximum tractive effort equal to one-fourth the weight on drivers. This factor varies slightly for different types of locomotives, but is the average value obtained from an analysis of a number of locomotives in service. If W represents the weight on drivers in pounds, then the formula for maximum trainload becomes $\frac{W}{60}$. Let it further be assumed that the maximum speed in miles per hour is equal to the number of inches (D) in the diameter of drivers. Making these substitutions in formulas (3) and (4), the following equations for steaming capacity are obtained:

For simple engines:

$$S = \frac{36,400\ H}{W \times D \times (D+8)} \quad \ldots\ldots (5)$$

For compound engines:

$$S = \frac{47,300\ H}{W \times D \times (D+8)} \quad \ldots\ldots (6)$$

In these calculations it has been assumed, of course, that all locomotive boilers have the same evaporative power per unit of heating surface. Such is evidently not the case, but in the absence of any definite information as to the relative efficiency of different types or designs of boilers, the extent of total heating surface is the best criterion by which to judge the capacity. If at some future date experiments are made to determine the relative efficiency of long and short tubes, or wide and narrow fireboxes, etc., it will then be possible to express the heating surface of every boiler in terms of an equivalent heating surface with the evaporative power of a square foot in the fire-box as the basis. In such an event, the values of H in the above formulas will be replaced by the value of the equivalent heating surface.

The following table shows the steaming capacities of a number of typical American locomotives, the dimensions of which are given elsewhere in this issue:

Passenger Engines.

Road.	Type.	Htg. surface.	Diam. drivers.	Wgt. on drivers.	Steam'g capac'y.
N. Y. C.	4-4-2	3,505	79	95,000	.195
Pennsylvania	4-4-2	2,640	80	109,000	.125
C. & A.	4-6-2	4,078	73	142,000	.177
Nor. Pacific	4-6-2	3,462	69	134,000	.177
C., C., C. & St. L.	4-6-0	2,858	78	134,000	.116
L. S. & M. S.	2-6-2	3,343	80	130,000	.133

Freight Engines.

Road.	Type.	Htg. surface.	Diam. drivers.	Wgt. on drivers.	Steam'g capac'y.
B. & O.	2-8-0	3,476	57	162,000	.210
P., B. & L. E.	2-8-0	3,805	54	225,200	.180
N. Y. C.*	2-8-0	4,117	51	198,500	.330
H. & St. J.	2-8-0	3,828	57	181,000	.210
N. Y., O. & W.	2-6-0	2,120	69	134,000	.110
Pennsylvania	2-6-0	2,469	62	140,300	.150

* Compound.

It will be noted that the steaming capacity of several freight engines is greater than that of any of the passenger engines. This apparent anomaly is due to the fact that the maximum load of both freight and passenger engines was taken as the equivalent of the maximum drawbar pull. Freight engines are rated close up to this standard, but passenger engines are seldom loaded beyond one-half their maximum starting capacity in order that the train can be accelerated rapidly. The steaming capacity factor in the above table gives the relation between the power of the boiler and the power which would be developed by the cylinders if the maximum trainload was hauled at the maximum speed as limited by the diameter of the drivers. For example, if the New York Central 4-4-2 engine having a steaming capacity of .195 was brought up to a speed of 79 miles an hour with a trainload of $\frac{95,000}{15}$ tons, then the boiler could develop but 19 per cent. of the power required to maintain that speed. Such a performance is, of course, impossible, but so long as only comparative values are required and freight engines are compared with freight engines, and passenger engines with passenger engines, no errors should result from the use of the factor as given. Whatever may be the utility of formulas (5) and (6) for estimating steaming capacity, the fact remains that the fundamental formulus (3) and (4) offer a ready and correct means of estimating the extent of heating surface in a locomotive designed for a given service.

Flattening of Driving-Wheel Tires.

A curious case of flattening is described in another column by an officer of the road where the trouble happened. The engines are in high-speed passenger service, hauling heavy trains over moderately heavy grades, and are a 4-6-0 type with piston valves and 73-in. drivers. The writer of the communication seeks an explanation of the cause of, and a remedy for, the flattening of the main tires about 60 deg. ahead of the crank on the left side and abreast of the same on the right side, the wear on the left driver being greater than the right.

This matter of irregularity of tire wear was widely discussed in 1890, and for several years thereafter investigations were made, records kept and theories offered in explanation of the cause. The work was done mostly on western roads, and the results were given in papers presented to the Western Railway Club. In 1895 a comprehensive report, embodying all of value from these papers and also the results of further investigations, was presented to the Master Mechanics' Association. Its data included records of investigations of the nature, location and extent of the irregularities in the wear of a large number of driving-wheel tires on eight-wheel and ten-wheel locomotives in freight and passenger service; calculations of the forces causing, or tending to cause, wear and irregularities, with deductions and conclusions. The calculations of the forces in action on a locomotive give the pressure of each driver on the rail for each ten deg. of revolution at three different speeds, namely, just starting, 40 miles an hour and 60 miles an hour for the eight-wheel engine; and just starting, 10, 20, 30, 40 and 60 miles an hour, respectively, for the ten-wheel engines. The total rotative force of both cylinders at the rail was calculated for each of the points, and also the ratio of

this force to the total weight of the drivers on the rail, this ratio being called "the coefficient of slip."

A wide variation in the total pressure of the drivers on the rails was disclosed. A ten-wheel freight engine, for instance, at a speed of 40 m. p. h. showed a variation of more than 22,000 lbs. in each revolution, although it was said this engine was balanced much better than many in regular service. At 60 m. p. h. this variation became nearly 51,000 lbs., from a minimum of about 60,000 to a maximum of about 111,000. This variation is almost entirely due to the overbalance, or that part of the counterbalance designed to balance the inertia of the reciprocating parts. At parts of the revolution the pressure of the drivers on the rail is much greater than the static weight on drivers, due to the angularity of the main rod.

Comparing the tables and diagrams of the forces in action on the locomotive with the diagrams showing localities and depths of wear, it was shown that the greatest wear corresponds with points at or near the maximum coefficient of slip. There are two kinds of slipping, one of which usually occurs during a small part of each revolution at slow speeds with heavy pulls. The other is when the drivers let go and spin around with considerable velocity. The counterbalance has effect only in the latter. The amount of abrasion to each tire that will ensue when the wheels slip is dependent on the pressure of the wheel on the rail; therefore the wheel, or wheels having the greatest pressure show the greatest wear from slipping. At the position of the cranks which would bring the position of the left main driver, referred to by our correspondent as the point of heaviest wear, in contact with the rail, the calculations show the coefficient of slip to reach its maximum. Also the right main driver has just passed its point of maximum rail pressure, which is therefore decreasing; but the left wheel is only just attaining its maximum, so that any slipping that occurs causes greater abrasion of the left main tire than of the right. The coincidence of maximum pressure of driver on rail with maximum coefficient of slip at this part of the left main driver is a result of the usual American practice of having the right crank lead. Roads having left-hand lead have found the difficulty transferred to the right driver, in the same relative position to its crank.

An interesting fact developed in these investigations had reference to an eight-wheel passenger engine belonging to one of the classes which showed considerable irregularity of wear in through service. This particular engine was used in suburban service, and therefore ran backward and forward. It showed practically no irregularity of wear.

The communication states that it is understood that a part of this flattening may be accounted for by the manner in which enginemen start out of the station the heavy trains that these engines pull. Perhaps the most important conclusion in the Master Mechanics' report is that most of the wear comes from the method of handling the engine—the slipping of the wheels when just starting—and that the wear from the increase in pressure from overbalancing is comparatively slight.

Judge Lacombe's order directing witnesses to reply to questions put by the Interstate Commerce Commission cannot be called unfriendly to the Commission, although he decides all of the principal points against it, for he says that if the contracts which are demanded had been found to contain anything relating to transportation rates, the railroads would have had to show them. As the alleged unfriendliness of the Courts toward the Commission is one of the points which many people wish to have cleared up, this result is worthy of note. The Commission will probably appeal from this decision, so we may yet have a fuller discussion of the matter. The immediate question now before the Commission is whether a railroad company has the right to buy coal in Pennsylvania and carry it to and sell it in New Jersey or New York (and, very likely it is one which the Commission will decide not to touch, for lack of jurisdiction). If that be settled or be assumed to be settled in the affirmative, the inquiry reverts to the original issue, whether the difference between the price paid in Pennsylvania and that received at the other end is a reasonable transportation charge. This question will be complicated by the claim that the railroad is entitled also, as buyer and seller, to a middleman's profit. Judge Lacombe did not deal with these points; he simply found, and declared, that the particular contracts in question do not go beyond the sale of the coal to the railroad company at the shipping point. The clause dealing with the price to be paid by the railroad has no reference to what the coal shall or may be sold for. If a thousand tons should be destroyed by fire before it left Pennsylvania, the price-clause would be unaffected.

As Judge Lacombe plainly intimates, this complaint had better have been made before the United States Court, as the Interstate Commerce law will probably be found not to apply to the acts which the railroad companies have done in maintaining or increasing their prices for carrying coal. The anti-trust law of 1890 is, probably, the appropriate statute. The Judge's suggestion that a complaint concerning coal rates ought preferably to come from a shipper, and not from a consumer with only a remote interest in the alleged overcharge, is all right, as a hint; especially in a case like this, where the complainant's chief or only purpose is to make a sensation; but it ignores one of the main purposes of Congress in establishing the Interstate Commerce Commission; which was to provide an investigating body to take up complaints which would be too vague or irregular to be dealt with by strict judicial procedure. Section 13 of the Act says that any person . . . may complain of anything done or omitted to be done contrary to the Act; and if there shall appear to be reasonable ground for investigating . . . it shall be the duty of the Commission to investigate . . . in such manner as it shall deem proper; . . . and no complaint shall be dismissed because of the absence of direct damage to the complainant. If we are to maintain the Massachusetts idea of what a useful investigating body should be, it is important to bear this feature in mind. People have spent so much time in mourning over the alleged weakening of the Commission by the decisions of the Courts that they seem to forget all about its real functions.

It is only in recent times, and after years of discussion, that water purification on a large scale for locomotive boilers indicates good commercial results. The developments of the last ten years in the locomotive, its increase in size and power, and its greater complication of parts have made the use of pure water necessary. Chemical processes now yield water practically pure for a small cost, but there are certain sections of the country where waters highly charged with alkali salts must be used, and in which chemical processes fail or are not economical. The announcement in another column that the Goss distilling apparatus has been used with success with water highly charged with alkali salts is a matter of the greatest importance to the railroads which operate in the alkali regions. Several years ago, the Master Mechanics' Association reported favorably upon the distillation of pure water for locomotives, but at that time there was no apparatus on the market which would operate with a sufficient degree of efficiency to warrant its use. *The Railroad Gazette*, June 22, 1900, said that "Whenever it can be shown that water can be distilled at a cost not greater than that which, under present practice, arises from the presence of impurities in untreated water, the matter becomes one of promise and merits attention." At that time the most economical apparatus in use was credited with delivering about 44 lbs. of water per lb. of coal burned. The Goss apparatus delivers from 70 to 80 lbs. of water per lb. of coal burned. The use of distilling apparatus should also be economical in the vicinity of large shops, where there is an abundance of exhaust steam which would otherwise be wasted. By this means large quantities of pure water can be obtained and the cost would only be that represented by the labor and by the interest and depreciation on the original investment. As the locomotive continues to improve in the refinement of its parts, the day may not be far off when the use of absolutely pure water is a necessity, and there appears to be a decided field for an evaporator possessing a high degree of economy.

TRADE CATALOGUES.

Catalogue "L" of the Kinnear Manufacturing Co., Columbus, O., is chiefly an album of engravings from photographs showing the variety of uses to which Kinnear steel rolling doors are applicable. One of the photographs was taken just after a fire in a lumber yard adjoining a building equipped with the doors. The appearance of the brick building denotes the fierceness of the heat, but its interior was protected from burning by the doors. In the back are engravings showing the details of the styles of construction for different applications. On the front of the book is mounted a photograph showing an entrance to an English tramcar house, with a car just coming out and a rolling door above the car.

Circulars Nos. 38 *and* 39 of the Chicago Pneumatic Tool Co. illustrate the types of pneumatic appliances of this company, and show views of these tools at work. No. 38 illustrates special applications of the Boyer drill and jam riveter, showing methods said to be entirely new. In one case the device is being used to clean a locomotive boiler crown sheet, and in another it is being used to expand tubes with a sectional tube expander.

Planing Machines is the title of catalogue No. 15 of the Betts Machine Co., Wilmington, Del. In it are described the various sizes of machines of this type which the company makes from 36 in. sq. to 120 in. sq. and any desired length. Many improvements have been embodied in these machines since the last catalogue was issued two years ago, and the tools shown in this pamphlet are thoroughly modern in every respect.

A large pamphlet catalogue gotten out by the *Gisholt Machine Company*, Madison, Wis., presents an attractive appearance. The large line of machine tools made by the company is illustrated by full page, half-tone engravings, with descriptive reading matter. Engravings are also shown of the variety in form of pieces that may be made on Gisholt turret lathes. A number of views of the factory are given on the last pages.

The Jeffrey Manufacturing Co., Columbus, O., has issued catalogue No. 72 of elevating, conveying and power transmission machinery. There are 372 pages and an index. It is profusely illustrated, showing reproductions from photographs of elevating and conveying machinery in actual use; also detail parts of this machinery, and brief illustrated references to other machinery made by the company.

Kinks, by the Railway Appliances Co., Chicago, states some facts and reasons as to why the Q & C Bonzano rail joint is a superior joint, securing perfect line, good surface and economy in maintenance. The facts, of which there are 17, are arrayed on the left-hand pages, and an equal number of reasons parallel them on the opposite pages. There is also given a large list of users of the joint.

Bollinger Bros., Pittsburg, Pa., have issued a catalogue of their car hauls, conveying appliances, etc., which contains photographs of a number of characteristic and difficult installations. The pamphlet is primarily designed for those interested in hauling coal, particularly at the mines.

The Elliott Electric Blue Print Co., Pittsburg, Pa., importers and makers of blue print papers, drawing instruments, transits, etc., has issued a new catalogue, of 194 pages, illustrated, dealing primarily with drawing materials and surveying instruments. The price of the catalogue is 50 cents.

The Missouri Pacific has issued an attractive pamphlet describing Glenwood Hot Springs, Colo. The illustrations are excellent half-tones, each occupying a full page, and a double-page engraving of the springs and hotel forms the center of the book.

The American Blower Co., Detroit, Mich., has a pamphlet on Morehead traps which explains the operation and advantages of return and tank traps, and contains instructions for setting up trap systems.

Demurrage.*

When freight cars are delivered at their destinations and placed for loading or unloading, their control in a measure passes out of the hands of the transportation officers, and their release for further service is dependent upon the diligence of the shippers and consignees, whose immediate interests are frequently at variance with the purposes of the railways—the owners of the cars.

In order properly to regulate the use of the cars at such times by non-owners, certain regulations have been established and have become formulated into a code that has been generally adopted throughout the country and known as the Car Service Rules. . . . To be completely effective, car service rules should apply to all commodities and take into account all the time that may elapse from the placing of a car subject to the use or direction of the shipper or consignee to its release for further movement. Failure fully to account for the time cars may be so held is evidence of the incompleteness of the rules, or a lack of efficiency in their enforcement. What is generally termed the earnings of a car under car service rules should be rigidly accounted for. The practice of reporting as earnings only those amounts which have been collected cannot be regarded as a satisfactory accounting. It is the duty of the car service manager to account rigidly for all the time that a car has been placed at the disposal of a shipper or consignee. Any less exacting method will bring disrespect on the rules and soon lead to their being regarded with indifference.

In the earlier days when cars were allowed to stand indefinitely, the abuses of equipment were without limit; and the experiences of those times have clearly shown that the conscience of the public is no safeguard. That much of the indifference then shown was due to thoughtlessness, encouraged at times by laxity on the part of the railroads themselves, did not lessen its harmfulness.

. . . An examination of the rules of various car service associations will disclose that in many instances the free-time allowance is extended to an unreasonable extent. These exceptions to the rule were made originally to enable consignees to adapt their business arrangements to new conditions, with the expectation that the exceptions could gradually be withdrawn. In many instances, however, the original purpose of the exception has been lost sight of, and free time in excess of 48 hours is still allowed when the necessity for such undue allowance no longer exists.

It can hardly be expected that the parties who receive the benefit of such allowance will ask to have their privileges curtailed; the initiative in such movement must come from the railroads, and no one is more competent to determine when such action should begin than are the managers of the car service associations, whose opportunities for investigation place them in a position to suggest the needed reforms and to urge upon the railroads the amendments to the rules that will bring about the desired results. In many localities such amendments have been made to the rules with advantage to the service; but what is needed is a more general movement in that direction. . . .

The storage of freight [in houses] is commended to your attention as a proper subject of regulation and control by your associations. There is no substantial difference in principle so far as the relations of a railroad and

*Extract from an address on Car Service (demurrage) in Its Relation to Operation, by A. W. Sullivan, Chairman of the Executive Committee of the Chicago Car Service Association and President of the American Railway Association, delivered before the annual convention of the National Association of Car Service Managers, at Chicago, June 16.

its patrons are concerned, between freight held in cars and freight held in warehouses, upon platforms, or on the ground.

In many States the statutes under which railroads hold their charters do not grant them the right to conduct a warehouse business, and this legal inhibition prevents the railroads from offering the use of their premises for warehouse purposes and soliciting public patronage; but there is a radical difference between public warehousing on one hand and the storage of freight that is forced upon the railroads by the failure of consignees to remove it, or of shippers to give the requisite shipping directions. In these circumstances the railroads have an undoubted right to make such a charge as will compensate them for such undue use of their premises and tend to cause the removal of the freight. The most reasonable basis of charging for such storage is the established car service charge of one dollar per car per day, reduced to a unit that will permit of less-than-carload quantities as well as carloads being charged for.

Assuming that the average weight of a carload of package freight is 20 tons, which when applied to all such commodities is a fair average, the storage rate which yields an equivalent charge to car service is five cents per ton per day. This ratio for storage, based upon the ton unit, regulates the amount charged proportionately to the space occupied; is a convenient one for purposes of calculation, and, while stimulating the removal of goods, does not work a hardship on the mercantile community. Storage rules upon this basis were adopted by the Chicago Car Service Association, and have been put into effect by all the railroads at Chicago. Their operation has been eminently satisfactory to the railroads and the merchants, and has afforded great relief from the congestion that formerly existed in all the railroad warehouses.

The per diem rate of 20 cents per car per day is an agreed rate for the reciprocal interchange of freight cars between the railroads that are owners and lenders of cars, and is quite a different thing from car service [demurrage], in which the element of reciprocity is entirely absent. There is therefore no reason why the existence of per diem should in any way modify the established car service rules or impair their efficiency. Car service and per diem are essentially different in principle, are intended to serve different purposes and should be kept separate in their application. The tendency which has become manifest in some quarters to substitute per diem for car service is fraught with danger to the integrity of car service rules, and should be resisted with all the power at the command of your association. The insidiousness of the movement is the more reason for you to be alert to its possibilities of undermining the car service system and wrecking the organizations which it is your work to administer and perfect.

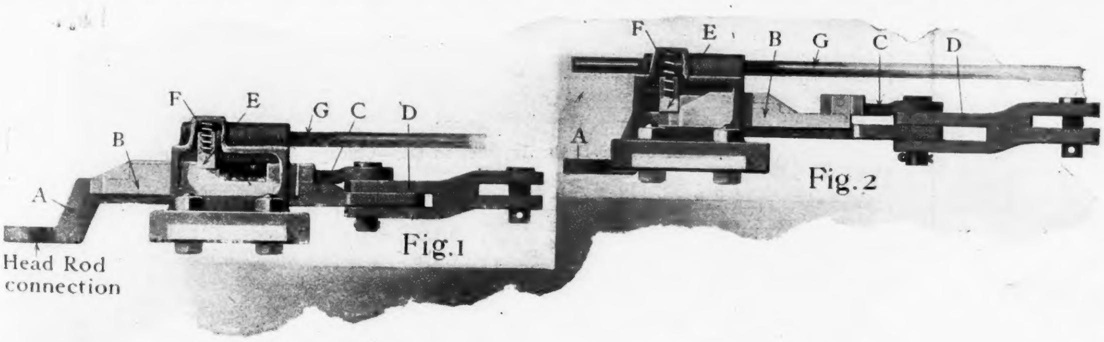
A clear distinction should be made between railroads which are common carriers dependent upon their revenues from transportation, and those railroads, whether incorporated or not, which are used primarily to transport the material or product of an industry or industries to and from a point on a railroad which is a common carrier, or those which are merely adjuncts to such industries. The lines which are common carriers and large owners of freight cars have established per diem as a basis for the mutual interchange of cars in the conduct of transportation service, and the benefits that accrue from such reciprocal relations are not to be extended to those railroads owning few or no cars whose interests are allied with and controlled by the industries they serve. Such industrial railroads should properly be placed on a car service [demurrage] basis in their use of cars belonging to the carrier lines, in order that the owner of the cars may exercise some adequate control over their use and undue detention.

An Automatic Detector Switch Lock.

The Coughlin swing-rail frog—which is not a frog but an ingenious method of avoiding the use of one—was described in the *Railroad Gazette*, Dec. 9, 1898. In connection with its use the Coughlin-Sanford Switch Company has designed and makes an automatic detector switch lock which prevents the target from indicating clear until the switch points are tightly closed and securely locked. Not until the switch is closed tight and the target completely turned can the switch tender shut the padlock.

Coughlin Swing-Rail Frog, with Automatic Detector Switch Lock.

The details and application to a single track turn out with swing-rail frog are shown in the accompanying engravings. The safety lock is enclosed in a snow and ice-proof box formed by the lock base, which is rigidly attached to the main rail by tieplates and a lock cap bolted to the base. It consists of a catch engaging the detector rod connected with the signal, operated by cam plates moving with the head rod connection and so arranged as to lock the detector rod and target at danger when the switch is open to any degree and to lock the head rod connection so the switch cannot be opened until the target is turned full to danger. Fig. 1 shows the position of the parts when throwing the switch to the siding. On the first movement of the locking lever on the switch stand the signal lever connected to it is pushed away from it, and the signal is set to danger; at the same time the detector rod G is withdrawn to the position shown. The switch and frog may then be thrown from the ground lever switch stand. The head rod or lock rod A, is moved by the link D, operated from the ground throw through a bell crank. As the lock rod moves out the latch E falls into the notch on the rod and locks the rod G so that the signal cannot be moved from danger. Not until the latch falls into this position is the switch set. The latch is moved up on the cam plates B by the releasing head C, the lock rod remaining stationary by reason of the slot through which the bolt of the releasing head moves.



To reset the switch for the main line, the ground lever is thrown over and pulls out the link D. Because of the slotted connection the lock rod remains stationary and the cam plates are drawn back, forcing the latch up. A further movement of the link pulls the lock rod A into the position shown in Fig. 2, when the latch falls into the proper notch releasing the detector rod. To lock the switch, the signal lever on the switch stand is thrown over, moving the detector rod over the top of the latch and turning the signal to safety. The padlock may then be closed and locked.

This device gives a protection at isolated switches like that which is given at crossings and in yards by interlocking, and without a large cost. It is simple, and trainmen or section men may be safely entrusted with its operation and care.

Keeler Curtain Fixtures.

The Keeler "Eccentric" fixture contains a mechanical principle not found in other fixtures. It has no pinch handles, cables, or other adjusting or retaining devices. The curtain can be raised or lowered by applying force at any point on its lower edge. It is self aligning. The lower edge of the curtain is always in a horizontal line. The guiding shoes cannot be accidentally thrown out of their grooves. They can be easily removed without tools when desired. The fixture runs equally well over varnished, or unvarnished surfaces, thus overcoming an objection found in so-called self-righting curtain fixtures. The fixture is self-adjusting as to varying distances between window jambs, and is, therefore, well suited for use in old cars. Its construction is simple and durable, and it requires few, if any, repairs.

As shown by the illustration, the only bearing and holding points in this fixture are the eccentrically pivoted rolls *a* which are mounted at the ends of the shoes, and are forced against the bottom of the groove *d* by the spring in the tube. This spring resists the rotation of the eccentrically mounted rolls which have gripping treads and serve to hold the curtain against the upward pull of the spring roller. The eccentricity of the rolls being slight, they revolve freely when enough force is applied to overcome the pressure of the springs against them; and the lower edge of the curtain remains horizontal even when such force is exerted at the extreme right or left hand edge of the curtain. The fixture is therefore actually automatically aligning, needing no squaring or retaining devices. The shoes are permanently attached to the plungers. The plunger is held in the tube by the pin c, which moves in the slot b, which are cut for them in the ends of the tubes.

The Keeler "Pinch Handle" fixture is simple and strong. The actuating handles are riveted to the rods and do not become accidentally separated from the fixture. The application of the fixture to a curtain is easily and quickly accomplished, as the rods are inserted in the tube at its center. The fixture is otherwise entirely assembled in the curtain before the springs and feet are

Keeler Pinch-Handle Curtain Fixture.

Keeler Eccentric Curtain Fixture.

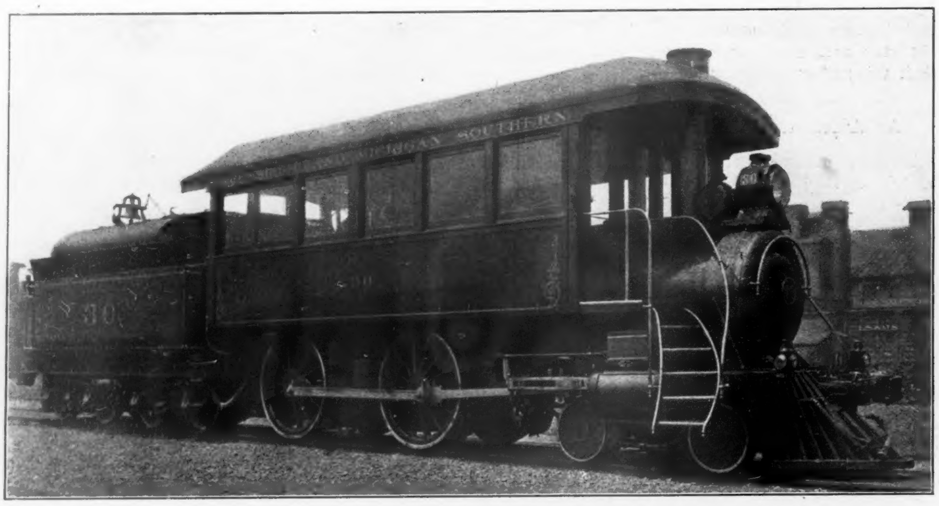
applied. The friction feet are made of solid castings, and having a long straight bearing surface, they square the bottom of the curtain, and give smoothness of action. As the feet are screwed upon the rod they can be readily adjusted to varying distances between window jambs by turning them outward or inward as may be found necessary.

The Keeler curtain cable adjuster insures the proper tension for cables in car curtains. With other appliances the cables are either too tight or too loose, and so the curtains do not wear well or give satisfactory service. When the Keeler curtain cable adjusters are placed in the bottom of the grooves, they prevent the shearing off of the cables. These adjusters are made in two sizes—one bronze for $^{1}/_{16}$ in. cables, and the other iron for $^{3}/_{32}$ in. cables. The Federal Manufacturing Company, of Cleveland, which makes the Keeler car curtain fixtures, has factories at Chicago, Milwaukee, Indianapolis, Cleveland and Elyria. These car fixtures will be exhibited at the Mechanical Conventions in Space No. 103.

In 1893 the railroad, telegraph and post office employees resident in Brussels formed a co-operative building and loan association. This year the association has completed its 500th dwelling in Brussels or its immediate vicinity.

New Inspection Locomotive on the Lake Shore.

The Lake Shore & Michigan Southern has a new inspection locomotive which was converted from one of its Class Q-2 type of engines. These are the American, or 4-4-0-type, with 17 in. x 24 in. cylinders, 62 in. drivers, and weigh 80,000 lbs., 50,000 lbs. being on drivers. The boiler pressure is 150 lbs. The clearance dimensions are, width 9 ft. 10 in., and height 14 ft. 10½ in. The length of the cab is 22 ft. 4 in.



New Inspection Locomotive for the Lake Shore.

In general appearance the design is similar to those of the Philadelphia & Reading and the Burlington. The boiler has been carefully insulated with asbestos to protect the cab interior from the heat, and the stack and front-end have a planished-iron covering.

The tender is steel, and the underframe is made of 10-in. channels. The hood over the top of the tank was put on to increase the coal capacity. It is closed by hinged doors 2 ft. 9½ in. wide and 3 ft. 3 in. long, there being three on each side of the center, and opening back from the same. The tender is also equipped with the standard Lake Shore water scoop, with pneumatic operating and locking device.

The engine has pneumatic sanding device, speed recorder, electric headlight and electric bells. The engraving is shown by courtesy of Mr. H. F. Ball, Superintendent of Motive Power.

Air-Brake Instruction Car for the Chicago & North Western.

The Chicago & North Western has just completed a new air-brake instruction car. The car, which was taken from passenger service, is 55 ft. 6 in. long and 9 ft. 10 in. wide and is divided into three compartments. The air-brake instruction room is 30 ft. long. The boiler room at one end, and the office and living apartment for the instructor at the other, are each 12 ft. long. The arrangement is such that all of the apparatus is in front of the class, and at the same time as much floor space as possible for the latter has been provided. As shown by the accompanying plan, there is room for 30 chairs, with space for an aisle. The arrangement and relation of the apparatus is apparent from this plan, and also from the engraving showing the interior of the car.

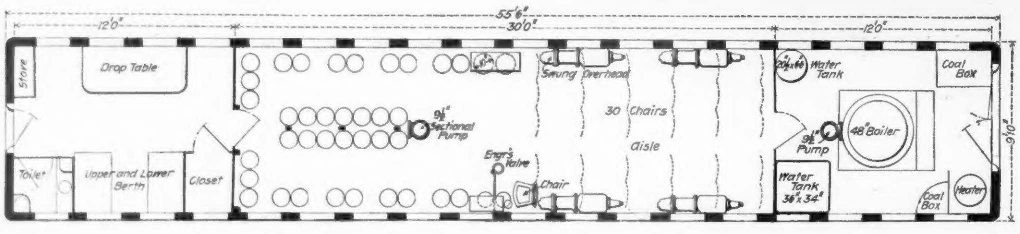
There is equipment for a 40-car freight train, a driver-brake, and for two passenger cars. This latter has the high-speed attachment. There is also a complete outfit of sectional apparatus, arranged in tandem with the working apparatus wherever possible. The sectional pump is placed at the front end of the center bank of freight equipment, just behind the instructor's table, and the sectional freight reservoir and brake cylinder are swung from the roof above the table. There is also an equipment of sectional apparatus for the use of the instructor, which may be mounted on his table as shown in the interior view.

Instead of the usual train pipe for the freight car equipment, each reservoir and cylinder has under it a 10x12-in. brake-valve equalizing reservoir, the capacity being such as to give, with the attaching pipes, the required train-line volume. They are connected in such a manner as to give the equivalent friction of a standard train line, this having been determined by time tests for both service and emergency applications, and for releasing. The advantage of the arrangement is its compactness, the reduction in weight, and also in the leakage incident to a considerable amount of piping in a confined space.

The car contains signal apparatus for a six-car train, and Pintsch gas equipment arranged for instruction purposes. There is also a cylinder arranged to show the effect of different piston travels. It is shown swung overhead on the left in the interior view. Swung from the deck immediately over the instructor's table is a wooden box 24 in.x30-in., the lid of which swings downward and back. The inside of this lid serves as a blackboard for the instructor. Within the box, mounted on rollers, are 18 standard color charts of Westinghouse apparatus, one of which is shown drawn down in the engraving. The blackboard is back of this.

All of the apparatus is painted a light color, which gives the interior a light, cheerful and attractive appearance. Steam is supplied by a 48-in. upright tubular boiler, with the 9½-in. pump mounted on the side. Two water tanks, boxes for coal storage, and a Baker heater for the car, are placed in the boiler room and the floor is covered with galvanized iron. The accommodations provided for the instructor at the opposite end of the car are shown in the plan.

Interior of Air-Brake Instruction Car—Chicago & North Western.



Floor Plan, Air-Brake Instruction Car—Chicago & North Western.

About nine months are required for the car to make the rounds of the North Western system, including two and one-half months in Chicago. The men are only required to come to the car once, but may come as often as they wish. The oral examination for enginemen has been discontinued. After passing one examination satisfactorily they are not required to take another unless there is evidence that they are neglecting to keep informed. It is found that the men take fully as much interest as they would if they expected to be examined after each annual instruction. Firemen have a first, second and third-year examination preparatory to their promotion to enginemen. For the first and second years the examinations refer principally to firing, with some questions on the details of the air-brake mechanism. The third year they are given the regular enginemen's examination.

Mr. L. M. Carlton, Air-Brake Instructor, had charge of fitting up the car, and we are indebted to him for the drawing and for information.

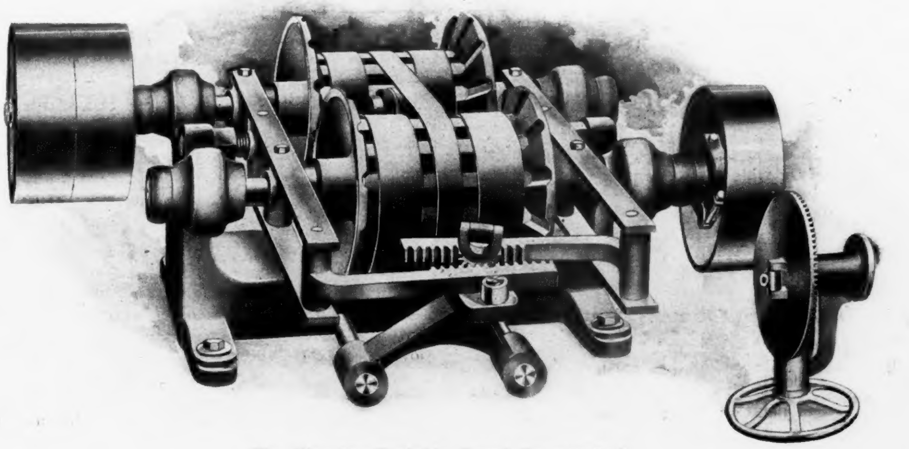
Simplex Variable Speed Countershaft.

One of the strongest arguments in favor of electric driving for machine tools is the factor of speed control. With a properly designed rheostat and gear train it is possible to drive the machine at an efficient speed for any cut or tool which accomplishes a saving of labor and power. In the average shop it is not possible to install a machine for doing each piece of work which may come in and the modern machine tool is being designed to do as many classes of work as possible on the same bed plate or spindle. Each class of work requires a certain cutting speed for maximum efficiency, and the possibilities of the step cone drive from a countershaft running at constant speed are very limited. There are two ways out of the difficulty, some form of variable speed countershaft or the use of the electric motor with control apparatus for changing the speed of rotation of the armature. The first has proved difficult of solution, and the second, the use of electric motors has made rapid advance.

The accompanying engraving shows a form of variable speed device which gives any desired adjustment of speed without excessive loss of power, the one great objection to most of the other devices for this purpose. Any variation of speed obtained by frictional contact means a loss of power, and this principle has been used in nearly all of the old forms of speed controllers. With the Simplex variable speed countershaft, the variation of speed is not gained by frictional contact but by a direct belt pull from the face of the drums. These drums are formed of wooden slats which travel in and out of milled slots in the face of tapered discs. Under all conditions, this construction gives a direct pull on the belt. The belt is run under idlers and there is never less than 270 deg. of contact on the drum faces. The side thrust on the discs is reduced about 10 times over that of the frictional contact devices, and this permits the use of rack and pinion instead of right and left screws for moving the beveled discs in and out. Three belts are used on the drums, two driving belts located next to the beveled discs and one retaining belt in the center of the drum, which passes over the idlers on the opposite side from the driving belts. The frame is made in one piece.

A speed controlling device is a feature of this countershaft, by means of which the proper speed may be readily obtained for any operation of the machine. Connected to the gear of the shifting rack and pinion is a hand wheel and an indicator dial. The dial face is marked for

the proper cutting speeds for different cuts, metals, etc., and when starting the machine the operator has only to turn the hand wheel until the indicator stands on the right notch for the work to be done, and the correct speed is at once obtained. This may be automatically operated with a star wheel feed to compensate for differences in diameter as the cut feeds in.



The Simplex Variable Speed Countershaft.

The efficiency of the countershaft is very high, a 10 h.p. drive with a ratio of 8 to 1 developing 98.75 per cent. They are made in any size from 1 h.p. to 500 h.p., and may be modified to suit any requirements. The Speed Control Co., The Bourse, Philadelphia, is the maker.

Some Recent Locomotives Built by the Vulcan Iron Works.

The accompanying illustrations show several locomotives recently built by the Vulcan Iron Works, Wilkes-Barre, Pa. The locomotive, Fig. 1, is a standard contractor's

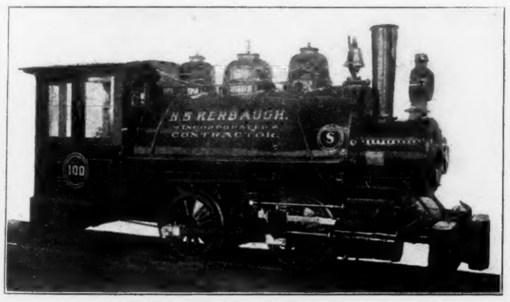


Fig. 1.—Contractor's Locomotive, Built by the Vulcan Iron Works.

locomotive weighing 24,000 lbs. The cylinders are 9 in. x 14 in., and the total heating surface is 225 sq. ft. The boiler is straight top and carries a working pressure of 150 lbs., and the drivers are 30 in. in diameter. The coal capacity is 500 lbs. and the tank holds 400 gal. This type engine is made in sizes from eight to 16 tons in weight, but the 12 ton machine is the one in general use.

Fig. 2 shows a locomotive built for the Lehigh Valley Coal Company. It is to be used in places where the height is restricted, which accounts for the low stack and uniform height. The engine weighs 50,000 lbs. and has 12 in. x 16 in. cylinders and 32 in. drivers. The total heating surface is 600 sq. ft. and the grate area is 15 sq. ft. The tank capacity is 800 gal. and the coal capacity is 1,000 lbs.

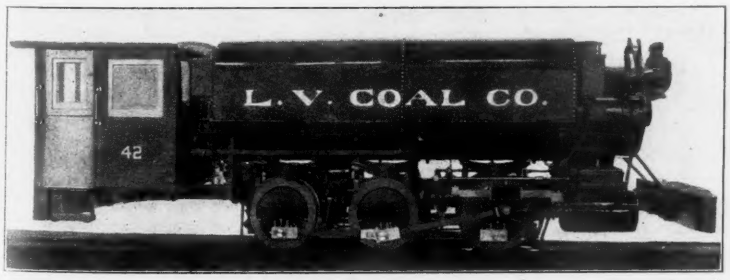


Fig. 2.—Locomotive For Inside Service, Built by the Vulcan Iron Works.

Fig. 3 shows a "culm" or dirt burner built for the Pennsylvania Coal Company. This design is of particular interest to those in the anthracite regions as a very low grade of fuel can be used. The grate is wide and has an area of 27 sq. ft., which is very liberal considering that the total heating surface is but 495 sq. ft. The total weight is 54,000 lbs., the cylinders are 12 in. x 18 in., and the drivers are 33 in. in diameter. The tank has a capacity of 800 gal. and the coal capacity is 1,000 lbs. The engine is equipped with a combination steam and hand brake. These engines are made in sizes from 12 to 30 tons in weight and are claimed to be good steamers.

Fig. 3.—"Culm" Burner, Built by the Vulcan Iron Works.

Foreign Railroad Notes.

The Siberian Railroad has asked for bids for the furniture for no less than 324 stations, open to all the world. Tables, washstands, sofas, and no less than 16,000 chairs (so reported, which would be nearly 50 per station) were among the articles. There were American bids, but the contract is said to have gone to a Berlin firm (which perhaps gets its goods from Grand Rapids).

Contracts for rails and rolling stock for the next three years for the Russian State Railroads are reported as follows: Rails, $36.86 per ton in 1903, $35.02 for 1904, and $32.80 for 1905. Box cars without brake (four-wheeled), $592; flat cars without brake, $580; hand-brake equipment for a flat car, $95; standard tank car, $920 without brake and $1,023 with brake. First-class passenger car, $9,120; second-class car, $8,580; third-class, $6,592; fourth-class, $1,813; eight-wheeled freight engine with tender, $16,480. All contracts are given out to Russian works, which have been suffering for lack of orders.

The Austrian Ministry of Commerce asks for an international competition for plans for passing vessels over the difference in level of the Danube-Oder Canal at Prerau in Moravia, the height to be overcome being 117½ ft. Prizes of $20,000, $15,000 and $10,000 are offered for the three best plans. The competitors have free choice of methods, but the amount of water available is limited. In case the execution of the work is not put in charge of the successful competitor, and his plan is carried out, a further reward of $40,000 will be given him. The plans must be handed in by the end of next March. Detailed information can doubtless be had on application at the ministry.

The Russian authorities have decided to build the railroad which is to connect Astrachan and the Caspian Sea with the railroad system of the empire along the lower course of the Volga down the left bank of that stream, which here consists ot two parallel main channels 15 to 25 miles apart, united by a complex of what we would call bayous, something like the country between the Yazoo and the Mississippi. Astrachan is on the left (east) bank of the main west channel, and to reach the east bank of the east channel (called the Achtuba) a large number of bridges must be built, among them three long ones. The course for 150 miles is northwest, near the bank of the Achtuba; thence nearly due north 260 miles to a junction with the railroad to Uralsk near the Volga, along two so-called "lakes," which are solid masses of salt, of unknown depth, sufficient to supply the world. One of them already is surrounded by a railroad 48 miles long, connected by a branch seven miles long with the Volga, through it having access to pretty much all Russia. About 290,000 tons a year for the last six years have been taken out; but the cavities from which it was taken have filled again. There are no railroads or navigable streams for hundreds of miles on either side of this part of the Volga; but the country is nearly all arid or semi-arid, having once, doubtless, been covered by the Caspian Sea, and the chief traffic expected is through Astrachan; which at present, with its 113,000 inhabitants and great trade, is pretty nearly shut out of the world in winter.

Interlocking Driver Brake-Shoe and Brake-Head.

An interlocking brake-shoe for cars was described in our issue of Oct. 24, 1902. The most important of the several advantages claimed for it was the great saving due to the practical consumption in service of the shoe. The same principle has also been made use of for a driver brake-shoe, for which a special interlocking head has recently been designed.

The form of the head and shoe, and the manner of interlocking the parts, are shown in the illustrations. The

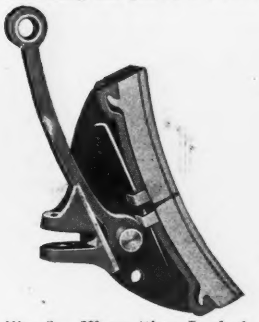


Fig. 2.—Worn Shoe Locked to New Shoe.

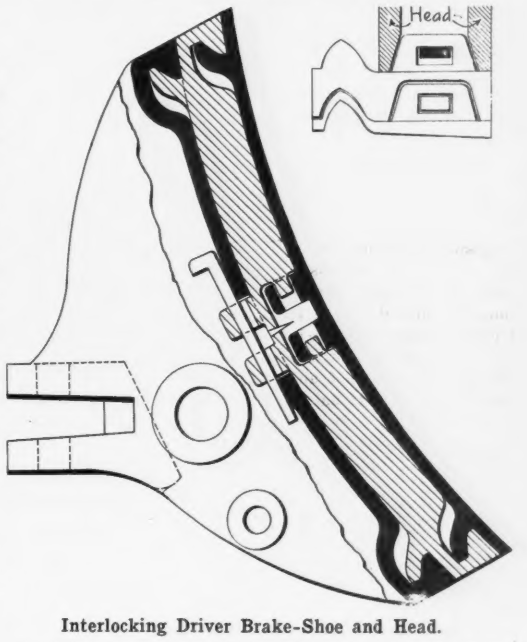
Fig. 3.—Holding Lug Lock.

Fig. 4.—Back of Shoe.

Fig. 5.—Pocket Face of Shoe.

Interlocking Driver Brake-Shoe.

shoe and head are pinned together, which does away with bolts and nuts, a consequent source of weakness, and makes the application of a new shoe a short and simple operation. The same procedure is followed with the driver brake-shoe as with the car shoe; that is, for first applications and for new equipment a plain-faced shoe is used. For second and subsequent applications the pocket-faced shoe is used, the worn shoe being locked to the face of the new shoe and used up completely, except a part of the lugs. This makes the scrap loss with these shoes practically nothing; while with the ordinary shoes,



Interlocking Driver Brake-Shoe and Head.

Partially worn shoe locked to face of pocket faced shoe and pinned to head.

which must be discarded when they have worn to the safe limit, this item means a considerable loss in the course of a year. It is claimed that the scrap saving on the first set of interlocking shoes applied will pay for the new heads required for further renewals.

The driver shoe possesses in its divided construction the same advantage as the car shoe, in the ability afforded to adjust itself to a proper bearing on the tread of the wheel, there being four points where contact is assured, giving an increased factor of safety.

The maker of the interlocking shoes is the Manufacturers' Railway Supply Co., Fisher Bldg., Chicago.

TECHNICAL.

Manufacturing and Business.

F. E. Place, heretofore Master Mechanic of the Illinois Central, has been appointed General Superintendent of the Buda Foundry & Manufacturing Company of Harvey, Ill.

The Nernst Lamp Co., of Pittsburg, has established a maintenance bureau for the purpose of supplying users of the lamps with new burners or holders, so it will not be necessary to call upon the electric light stations when a lamp gives out. The maintenance bureau makes a contract to supply to its customers a certain number of extra holders which are kept in a box especially made for this purpose, and delivered by messengers.

The Allis-Chalmers Co. has received the contract for the grinding machinery and rotary kilns for the 4,000 and 2,000 barrel cement plants which are being erected by the U. S. Steel Corporation at the Illinois Steel Co. plant at South Chicago, and the Carnegie Steel Co. plant at Pittsburg. The order consists of 28 Gates Ball Mills (No. 8), 39 5 ft. by 22 ft. Gates Tube Mills, and 24 rotary kilns of special design, and is said to be the largest individual cement machinery contract ever placed at one time with any one concern.

William Burlingham has become Chief Engine Designer for the B. F. Sturtevant Co., of Hyde Park, Mass., resigning a position in the United States Inspection Office with the Wm. R. Trigg Co., of Richmond, Virginia. Mr. Burlingham has previously worked with the Bath Iron Works, the General Electric Co., the Southwark Machine & Foundry Co., and the Newport News Ship Building and Dry Dock Co. He has also served on T. A. Edison's staff at the East Orange Laboratory and is a graduate of the Worcester Polytechnic Institute.

Iron and Steel.

The Riverside Bridge Co., of Wheeling, W. Va., has increased its capital from $125,000 to $200,000.

The Colorado Fuel & Iron Co. is said to have purchased iron ore deposits valued at $1,000,000 in the Sahuaripa district, State of Sonora, Mexico.

The Alan Wood Co. and the Alan Wood Iron & Steel Co. of Philadelphia, Pa., have merged to form the Wood Iron & Steel Co., with a capital of $3,500,000.

The State Highway Track Construction Co., capital $200,000, has been incorporated in Camden, N. J., to make steel rails for use on improved wagon roads.

The iron works of Springfield and Aurora, Mo., and Iola, Kan., have been consolidated, and articles of incorporation of the new company, known as the United Iron Works Co., have been filed, with a capital stock of $650,000.

The Struthers Furnace Co., Struthers, Ohio, has elected officers as follows: President, W. C. Runyon; Vice-President, J. D. Stubbs; Treasurer, A. Grossman; Secretary, Geo. L. Fairbank; General Superintendent, S. A. Richards.

The D. G. Henry Co. has been incorporated at Buffalo, N. Y., to erect iron, steel and metal buildings of special construction, under patents issued to D. G. Henry. The directors are: D. G. Henry, Geo. W. Butler and Chas. Diebold, Jr., of Buffalo.

The Wheeler Forge Rolled Steel Wheel Co., 419 Market street, Camden, N. J., has been incorporated with a capital of $300,000, to make steel wheels, railroad equipment, etc. The incorporators are: Frank A. Wheeler, W. A. Hemick and Albert H. Moeser.

Battleship Contracts Let.

In accordance with the recommendation of the Naval Board on Construction, Secretary Moody has accepted the three lowest bids for the construction of the 16,000-ton battleships "Minnesota," "Kansas" and "Vermont," bids for which were recently opened. The bids accepted are as follows: For the "Minnesota," the Newport News Shipbuilding & Dry Dock Co., of Newport News, Va., for $4,110,000; for the "Kansas," the New York Shipbuilding Co., of Camden, N. J., for $4,165,000; and for the "Vermont," the Fore River Ship & Engine Co., of Weymouth, Mass., for $4,179,000.

New Locomotives for Prussian Railroads.

Consul Brainard H. Warner, of Leipzig, says that the Prussian Government has just placed an order for 317 locomotives, of different kinds, with the firms that have heretofore built engines for the State railroads. They are to be delivered by April 1, 1904. In a later report, the consul adds that 476 passenger cars, 62 baggage cars, and 3,920 freight cars have also been ordered. It is said that these cars, which have about three-tenths the carrying capacity of those used in the United States, represent the regular needs of the Prussian railroads for 1904. The orders are given this year on account of the lack of work in the car shops.

Oiled Roadbeds in New Mexico.

Near El Paso the Southern Pacific Company is using oil, in cuts, to stop the drifting of sand over its tracks. This plan was contrived by Mr. Bienenfeld, engineer of that company, who rigged up a derrick 30 ft. high on a flat car on which a movable nozzle is mounted, connected to a pumping engine on the car which has a tank of oil coupled to it. The machine is capable of throwing oil over 50 ft. A quantity of oil sufficient to soak into the sand for an inch is used, forming a hard crust which has stood a very severe test, recently, during one of the hardest windstorms for years. The same storm blew down many sand fences on the El Paso & Southwestern and drifted sand to a depth of two and three feet over the tracks. The oiled portions of the cuts on the S. P. were not disturbed.

The Vanderbilt Tender.

The following is an extract from a letter by Mr. W. R. McKeen, Jr., Superintendent of Motive Power & Machinery of the Union Pacific, read at the April meeting of the Southern & Southwestern Railway Club. The Vanderbilt tender is preferred for the following reasons:

Its center of gravity is low and hence there is less rocking motion in going around curves and less liability of derailment.

There are no dead spaces for the accumulation of cinders and other refuse which corrodes and eats the metal.

The coal is convenient to the firemen, avoiding unnecessary shoveling.

There is no expensive tender frame to maintain as in the cistern type of tenders, and the trucks are open and are easily inspected.

Locomotive and Car Performances, Louisville & Nashville.

The Louisville & Nashville sends the following statements of locomotive and car performance for the month of April, 1903, as compared with April, 1902.

Locomotives.

Kind of service.	Number of locomotives in service. 1903.	1902.	Average mileage. 1903.	1902.	—Valve oil.— Miles to one pint. 1903.	1902.
Passenger	94	99	5,546	5,259	96.02	102.74
Freight	304	278	4,161	4,105	52.91	55.34
Mixed	21	23	2,963	2,666	75.32	87.46
Switching	134	116	3,945	3,896	65.12	74.50
Work train	13	21	3,216	2,877	65.13	73.06
Total	566	537	4,220	4,163	62.28	67.17

Kind of service.	Lubricating oil. Miles to one pint. 1903.	1902.	Cost of valve and lubricating oil. Per 100 miles, cts. 1903.	1902.	Cost of waste for lubrication. Per 1,000 miles, cts. 1903.	1902.
Passenger	21.76	21.45	14.62	20.47	29.07	29.72
Freight	20.00	21.94	19.61	25.75	30.69	28.60
Mixed	29.37	31.46	13.34	17.10	23.48	19.38
Switching	39.16	43.53	11.74	14.43	15.05	16.39
Work train	28.10	29.42	14.96	19.19	20.16	20.95
Average	23.23	24.66	16.54	21.82	.26.51	25.93

Kind of service	—Coal.— Pounds per mile. 1903.	1902.	—Roundhouse expenses.— Wages. 1903.	1902.	Supplies. 1903.	1902.
Passenger	93.72	86.98	$8,916	$8,171	$1,416	$1,222
Freight	176.13	156.29	23,163	19,514	3,435	3,045
Mixed	95.68	86.89	1,078	917	140	135
Switching	83.40	78.34	...	...	1,318	1,166
Work train	94.32	92.41	...	...	...	...
Average	134.09	120.80	$33,158	$28,603	$6,311	$5,569

Cars.

Kind of service.	—Mileage.— 1903.	1902.	Lubricating oil. Miles to one pint. 1903.	1902.
Pass. and sleepers	2,770,917	2,762,176	248	253
Freight	24,222,082	23,129,747	223	286

Kind of service.	Cooling compound. Miles to 1 lb. 1903.	1902.	Lubricating oil and cooling compound. Per 1,000 miles, cts. 1903.	1902.	Waste for lubrication. Per 1,000 miles, cts. 1903.	1902.
Passenger	3,138	2,550	9.20	14.19	5.74	5.81
Freight	19,300	8,371	8.55	9.11	10.42	8.59

THE SCRAP HEAP.

Notes.

A new freight tariff, recently issued by the Pennsylvania Railroad, abolishes the milling-in-transit privilege which has been enjoyed by flour millers in Eastern Pennsylvania for many years.

A landslide which occurred on June 12 near Tryon, N. C., at the foot of Saluda Mountain filled a cut of the Southern Railway with such an enormous mass of earth that, according to report, the line will be blocked for at least a week.

According to the *New Orleans Times Democrat*, the marine insurance companies will now insure flour by policies containing the "all risk" clause; and, therefore, flour can be shipped to Europe by way of New Orleans in the summer as well as in winter. Hitherto, the risk of damage from weevils has been so great in hot weather that the export flour traffic through New Orleans has been mostly confined to the cool months.

According to a press despatch, two robbers were captured in an express car of train No. 8 of the Erie Railroad, at Huntington, Ind., last Thursday night in consequence of the discovery of their work by a freight train following No. 8. The robbers had entered the car just outside of Chicago and had thrown off numerous packages along the road. These were seen by the freight trainmen, who telegraphed the facts to Huntington.

The State Corporation Commission of Virginia, the recently established body which supervises railroads in that State, has issued an order requiring the railroads to report accidents to the commission; and the reports are to be sent within 24 hours after the occurrence of the accidents. The blank prescribed for these reports is headed "Preliminary Report;" the Commission has not yet taken final action as to the form of the permanent reports.

The Supreme Court of Tennessee has declared unconstitutional the law of that State which aimed to separate blacks from whites in street cars. It appears that there has been strong opposition to the law, not alone from the negroes, but on account of the inconvenience of attempting to separate the two races without a partition, and because it is very uneconomical for the railroad companies. This matter of driving one class of passengers to one end of a car and another class to another end seems to be the cause of more or less friction in Virginia. The electric road from Washington, D. C., to Alexandria and Mount Vernon has a rule of this kind, and every little while we read in the newspapers of some passenger being ejected or arrested for refusing to comply with the regulation; and white persons appear to be offenders oftener than the blacks.

Pennsylvania Exhibit at St. Louis.

The exhibit which is to be made at the St. Louis exposition by the Pennsylvania Railroad—which means, of course, the whole Pennsylvania System, both east and west of Pittsburg—is to include a complete locomotive testing plant, in which tests of various types of locomotives will be made during the progress of the exhibition. As noted in another column, Mr. Ely has engaged Mr. Casanave to prepare and manage this exhibit.

Capital for New High Speed Electric Line.

Under the title of the "Mono Rail Construction Co., Ltd.," there has just been registered in England a company whose principal object will be to undertake the issue of the capital for the electric high speed mono rail between Manchester and Liverpool authorized by Parliament, on which it is proposed to run cars at 110 miles an hour, the journey being accomplished in 20 minutes, or half the time now taken by the quickest express trains. The entire capital stock of the company, amounting to £60,000, has been privately subscribed.—*Herapath's Railway Journal.*

Honduras Seizes Railroad.

The steamer "Breakwater" from Puerto Cortez, Honduras, reports at New Orleans that the Honduras Government has confiscated the railroad running from Puerto Cortez to San Pedro, 58 miles. This road is owned by a Honduras syndicate composed of many well known Americans. Chauncey M. Depew, of New York, is President, and H. L. Sprague, Vice-President. President Bonilla, of Honduras, states that the road was confiscated because the operating company had violated its concession. The American Minister at Tegucigalpa has protested against the seizure.

Destruction of the Town of Heppner, Oregon.

By a flood, resulting from a cloudburst, which occurred in the valley of Willow Creek, Oregon, on the night of June 14, 200 or more persons were drowned, and the village of Heppner was practically destroyed. Heppner is the county seat of Morrow County and had about 1,250 inhabitants. It is the southern terminus of the Heppner branch of the Oregon Railroad & Navigation Company's line. The junction with the main line is 152 miles east of Portland. Considerable damage was done at Lexington and Ione, more than 15 miles from Heppner, which would seem to indicate that the railroad probably had suffered severely.

The British Military Railroad Council.

English newspapers announce the reorganization of the Army Railway Council, the body which was formed at the time of the South African war to advise the Commander-in-Chief on railroad matters, and which still exists to give advice in the event of mobilization. A number of new members have been added, and the list now includes Lieut.-Colonel Sir F. Harrison, London & North-Western; Lieut.-Colonel Sir J. F. Wilkinson, Great Western; Lieut.-Colonel J. F. S. Gooday, Great Eastern, Lieut.-Colonel Sir C. J. Owens, London & South-Western; Lieut.-Colonel R. Millar, Caledonian; and H. Plews, Esq., Great Northern (Ireland).

Railroad Projects in Portugal.

A comparatively extensive railroad construction programme is projected by the Portuguese Government, the probable cost running into £2,400,000. One of the most practical items is the "Oporto Suburban Line." It joins the lines of Minho and Douro with the port of Leixoes. It will thus facilitate the development of the rich iron and coal region of Moncorvo, while immensely serving the interests of the local wine-growers. No less important will be the line from Pocinho to Miranda, 120 kilometers, into the province of Traz-as-Montes, which contains the iron mines of Roboredo, the marble quarries of Vimioso, and is rich in mines of tin and wolfram. The line proposed from Sado to Sines is the longest of all—180 kilometers. The valley of the Sado is a rich agricultural region, and has a great number of mines which at present suffer from lack of transportation facilities.—*Herapath's Journal.*

Legal Negligence in Loading Rails on Moving Cars.

In the case of La Barre vs. the Grand Trunk Western there was much testimony tending to show, without any proof to the contrary, that the general method of loading upon moving cars, with gangs of men taken from section gangs, rails taken up from an old track, was the ordinary method of doing such work; therefore the Supreme Court of Michigan holds (94 N. W. Reporter, 735) that the adoption of that general method was not negligent. However, while the general method of loading rails on moving cars may not be negligent, the court says that there may be circumstances under which it is not prudent, and when to keep the train in motion might be negligence on the part of the person responsible therefor. The man in charge of the work is bound to see that the men are not overworked through undue haste; but whether the railroad company is free from accountability or not must depend upon whether such person is to be held a fellow servant or not.

Brooklyn Rapid Transit Plans.

It has been officially announced that the Brooklyn Rapid Transit Co. will make the extensions and improvements proposed by Chief Engineer Wm. B. Parsons. The estimated cost of the work is approximately $20,000,000. A subway is projected, from the Manhattan end of the Williamsburg bridge to connect with the Manhattan subway at Centre street; thence down to Maiden Lane and back to Brooklyn by another tunnel, with an outlet at the foot of Orange street. This plan is designed to provide a loop for the trains which come down Broadway (Brooklyn), go over the Williamsburg bridge, connect with the other bridges in Manhattan and return to Brooklyn through the new Brooklyn tunnel, thence proceeding on the Fulton street line. The plans also call for the placing of a third track on all the Brooklyn Elevated lines; the building of lines extending from Franklin avenue to Blackwell's Island and the Williamsburg bridge, and minor extensions. It is estimated that the entire work will require three years for completion.

A New Version—Only 2 Minutes Ahead.

At Cameron last Saturday night, on the Austin branch of the Houston & Texas Central, a Texas mustang was loaded into a box car for shipment to Austin. The car was secured and an aperture was left as an air hole. The long freight train started on its lumbering way and was making 12 or 15 miles an hour. The broncho became inquisitive over the opening and investigated. It got its nose out and then its head through. It eventually pressed against a clamp on the outside, which gave away and left an opening big enough for it to jump out. It took the perilous leap and landed on all fours and without being injured. Mr. John O. Craig, of Houston, who was on the train, witnessed the act and at once notified the conductor. The train was brought to a halt and a half hour was put in trying to capture the animal. It was at length cornered and lassoed. After being caught there was no practical way of getting it back into the car. The dilemma was finally straightened by a negro volunteering to ride it to Ledbetter, the next stop and some six miles away. He mounted and went at a full gallop. When the train pulled in the broncho and darkey were there, having arrived two minutes ahead of the train.—*Galveston News.*

The Kansas Floods.

The extent of the floods at Topeka and Kansas City was briefly indicated in the report printed in our last issue. Among the vague and unsatisfactory estimates of the losses sustained by the different interests, the most definite obtainable are those gathered by reports among railroad officers in Chicago. Traffic to and from the cities named was very seriously interfered with, if not entirely suspended, for almost two weeks. An officer of the Burlington road is quoted as saying that the loss falling on his company will be $1,000,000. The Atchison and the Rock Island are the next largest sufferers among the railroads. The loss of freight in freight houses and in cars can only be very roughly estimated. In some of the freight houses the mud left on the subsidence of the floods was 2 ft. deep. The damage to the Atchison at Kansas City and Topeka, and between these cities, is stated at $150,000, which presumably refers only to the damage to the roadway and structures.

At St. Louis, passenger traffic over the bridges was suspended for at least four days. Serious damage was done to the approaches to the bridges and the flood in the Mississippi subsided very slowly. For practically the whole of last week the only way of sending freight to St. Louis from the East was by taking it in boats from Alton; and for most of this time the passenger traffic had to be carried over the same route.

"Surprise Checking" of Locomotive Runners.

The Division Superintendents of the Southern Pacific have been instructed to institute a series of tests of the watchfulness of engineers and the extent to which they obey the company's rules concerning the observance of danger signals. It is reported that in consequence of these tests one engineer has been discharged and about 30 suspended.

The tests have consisted of the placing of false signals in front of approaching trains, trusted agents having been charged with the duty of transposing switch lights, placing fusees and torpedoes on the track and manipulating semaphore signals to test the watchfulness of engineers. It is stated that in a number of instances engineers have overrun the signals without slackening the speed of their engines, one of them running over a fusee that shot up a flame three or four feet high between the rails; and that several ran over torpedoes without stopping, and that in all these cases the engineers have been suspended.

Manager Agler says the tests are for the good of the men as well as that of the public and the company, and that it is hoped that these tests will keep the engineers constantly alert while running their trains; that all engineers know that it is their duty to stop when they see such danger signals, and the company hopes by means of the tests to establish perfect discipline and bring up all the engineers and trainmen to an appreciation of the importance of rigidly observing the regulations.

The engineers protest against the false signal tests, which they say put them into jeopardy, and that the display of the false signals is likely to cause the firemen to jump and be maimed or killed when the danger signals flash up unexpectedly before them; also that it flattens the wheels and piles the passengers up in a heap when there is no necessity for it. They say James McCreagh, who has been in the company's employ 27 years, 23 of them as an engineer, and had only been on the "Brown list"—the system of rewards and punishments—30 days in all that time, was discharged for overrunning a red switch target, when he was running 70 miles an hour with the Del Monte express, although he stopped so quick that he jolted his passengers up pretty hard. They also say that Engineer Russ Hurd, who has been on the road 20 years, was suspended for 45 days when he saw the rails clear ahead and the switch closed, but ran past the red switch target before he could stop. It is claimed that he stopped so quick that it threw some of the passengers off their feet. Other engineers were suspended for similar causes. One fireman came near jumping when his train was going 50 miles an hour, and he suddenly saw the green lights, indicating the rear of train just ahead of him.

The engineers and firemen are putting their complaints in the hands of their Grievance Committees, and demands will be made for a cessation of the tests by false signals. —*Sacramento Record-Union.*

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xviii.)

Central Railway Club.

The next meeting will be held at Buffalo on September 11. The safety appliance laws will be discussed at this meeting, and a trip will be made to the plant of the Lackawanna Steel Co.

American Society of Mechanical Engineers.

The forty-seventh meeting will be held at Saratoga, N. Y., June 23 to 26. The headquarters will be at the United States Hotel. The programme follows:

Opening session, Tuesday, June 23, 8:30 p. m.—Welcome, Albert L. Rohrer, Chairman Local Committee; response, James M. Dodge, President of the Society. Papers—"United States Army Gun Factory at Watervliet Arsenal, N. Y.," J. M. B. Scheele; "Test of Hydraulic Elevator Plant," R. P. Bolton; "Rational Train Resistance Formula," John Balch Blood. Reception and smoker.

Wednesday, 10 a. m.—Session for the report of tellers and committees, discussion of proposed constitution, by-laws and rules, and general business. Papers—"Turbine Flow Recorder," Chas. M. Allen; "Some Data on Hoisting Hooks," John L. Bacon; "Strains Produced by the Excessive Tightening of Nuts," A. Bement.

Wednesday, 2:30 p. m.—"Indicating Anglemeter," C. E. Sargent; "Recent Practice in Forcing, Shrinking, Driving and Running Fits and Limits for Limit Gages," Stanley H. Moore; "Graphical Daily Balance in Manufacture," H. L. Gantt; "Shop Management," Fred. W. Taylor; "Steam Turbine from Operating Standpoint," F. A. Waldron.

Wednesday, 8:30 p. m.—Informal entertainment, Ball Room, United States Hotel.

Thursday, 9:30 a. m.—Papers—"Experiment Boiler of Ohio State University," E. A. Hitchcock; "Curves of Water Consumption for Various Horse-powers of Several Engines," D. S. Jacobus; "Drawing Office Equipment," J. McGeorge; "Bursting of Emery Wheels," C. H. Benjamin; topical discussions.

Thursday afternoon.—Excursions to various points. Consult bulletin boards in headquarters for further information.

Thursday evening.—Reception at 9 o'clock, followed by dancing.

Friday, 10 a. m.—Excursion to Schenectady.

Friday, 1 p. m.—Union College Chapel, Schenectady. Papers—"A 60-foot Boring Mill," John Riddell; "Alternating Current Motors for Variable Speed," Walter I. Slichter; "Positive Governor Drives," A. H. Eldredge.

Friday, 2:45 p. m.—Schenectady. Visit to the General Electric Company's shops. Return to Saratoga at 5:15 p. m.

Friday, 8:30 p. m.—Papers—"Test of 12 h. p. Gas Engine," C. H. Robertson; "Internal Combustion Engine Using Kerosene as Fuel," H. F. Halladay and G. O. Hodge; "Gas Engine Testing," E. C. Oliver; "Mechanics of Air-Brake Systems," H. G. Manning; "Hot Well as Oil Extractor," A. H. Eldredge; "Comparative Oil Tests," W. F. Parish; "Test of 8-foot Fan Blower," E. S. Farwell.

PERSONAL.

—Mr. Jonathan Tipton, Division Freight Agent of the Southern Railway, died at Knoxville, Tenn., June 16.

—Mr. H. H. Vreeland, President of the Interurban Street Railway Company, New York City, is going to England next month and will be called before the Royal Commission which is investigating the means of locomotion and transportation in London.

—Mr. Clifton Jones, of Columbus, Ga., who until a few months ago was Division Freight Agent of the Southern Railway, and General Freight and Passenger Agent of the Georgia Midland, before its lease to the Southern, died from morphine poisoning June 9, aged 44 years.

—Mr. S. J. Anderson, Master Mechanic of the Atlanta, Knoxville & Northern, who died recently as the result of injuries received in a collision of freight trains at Isabella, Tenn., was born at Knoxville, and was 41 years old. For a number of years he was a machinist for the Southern Railway and about two years ago became Assistant Master Mechanic of the Atlanta, Knoxville & Northern at Blue Ridge, Ga. He was given the full title about the first of the present year.

—Mr. C. W. Burpee, the new Superintendent of the Canadian Pacific at Brownville Junction, is 42 years old and was born in York County, New Brunswick. He began railroading in 1877 as a yardman for the New Brunswick Railroad. Subsequently he served as brakeman and car inspector, and in 1884 was promoted to the position of roadmaster. He continued in this capacity at various places after the New Brunswick was taken over by the Canadian Pacific. Mr. Burpee was transferred from St. John to Brownville Junction as Superintendent on the first of May, this year.

—Mr. W. L. Holman, Master Mechanic of the Pennsylvania Railroad at Renovo, died recently. In 1860 he took a position in the Fort Wayne shops, later going to Allegheny. In 1867 he was made Master Mechanic at Kane, and was transferred to Renovo in 1880, where he remained until his death.

—Mr. F. D. Casanave, who lately resigned the position of General Superintendent of Motive Power of the Baltimore & Ohio, has been engaged by the Pennsylvania to take charge of the preparation, installation and management of the exhibit which the company is to make at the St. Louis Exposition. He will report both to Mr. Ely at Philadelphia and to Mr. J. J. Turner, Third Vice-President of the Pennsylvania Lines West of Pittsburgh. Among the exhibits to be made by the Pennsylvania at St. Louis will be a locomotive testing plant.

—Hon. Rufus Starr Pickett, a lawyer of New Haven, Conn., who died in that city last week, at the age of 73, had a somewhat unusual career, having been a car repairer for the New York, New Haven & Hartford Railroad until he was past 40 years old. He had been Judge of the City Court for a number of years and had presided at the trial of important suits. He was actively engaged in the practice of law up to about one month ago. Although beginning his education for the law late in life he won the Jewell essay prize at his graduation from the Yale Law School.

—Mr. F. S. Lewis, the new Superintendent of the Illinois Southern at Sparta, Ill., was born in Vermillion County, Ind., in 1865. His railroad experience began in 1883 with the Chicago & Eastern Illinois as an operator, and he has served successfully as assistant agent, relief agent, and assistant train despatcher. In 1889 Mr. Lewis resigned to go to the Chicago & Calumet Terminal at East Chicago as agent and train despatcher. The following year he was made Trainmaster, where he remained until June of that year (1890), and when the Chicago & Northern Pacific took control of the line he went to Chicago as chief operator. Then for a time he was with the Illinois Central, and in 1896 he returned to the Chicago & Eastern Illinois, as chief clerk in the Superintendent's office at Brazil. In 1897 he was promoted to be despatcher, and in 1900 he was made chief despatcher at St. Elmo, Ill., which position he now resigns to go to the Illinois Southern.

—Mr. H. E. Nettleton, the new Assistant Superintendent of the Shore Line Division of the New York, New Haven & Hartford at New London, Conn., has been in the service of this company for the past 21 years. He began work in 1882 as stenographer to President G. H. Watrous, and in May, 1886, was transferred to the office of General Superintendent Shepard. In 1890 Mr. Nettleton was appointed chief clerk in the office of the General Manager, later assuming similar duties in the office of the

General Superintendent, where he remained until the first of this month, when he was appointed Assistant Superintendent at New London.

—Mr. J. B. Gannon, Master Mechanic of the Central New England at Hartford, Conn., has been in railroad service since 1875. He began in the shops of the New Jersey Midland (New York, Susquehanna & Western); from 1878 to 1881 was a fireman, and then was promoted to be an engineman. He later became engine despatcher of the Hudson, Harlem & Putnam Divisions of the New York Central at Mott Haven, N. Y. From 1897 to 1898 he was Master Mechanic of the Louisville Division of the Southern Railway at Louisville and from the latter date, up to his new appointment, Mr. Gannon was Trainmaster of the Washington Division of the Southern at Alexandria, Va.

—Mr. G. H. Wilson, who has succeeded Mr. O. M. Shepard, with the title of Acting Superintendent of the New York Division of the New York, New Haven & Hartford, began his railroad career as a telegraph operator on the Belvidere Division of the Pennsylvania Railroad in March, 1884. For two years (1885-1887) he was with the Central of New Jersey as operator and train despatcher at Elizabeth, N. J. From 1887 to the present time he has been with the New Haven road as train despatcher and chief train despatcher. Mr. Wilson's office is at Grand Central Station, New York city.

—Mr. Edward F. Grafstrom, Mechanical Engineer of the Atchison, Topeka & Santa Fe, whose sudden death was announced last week, was one of a party of men who were engaged in the work of rescuing the residents of North Topeka. Mr. Grafstrom's death occurred on June 2, and the party, of which he was one, was on board a gasoline launch which struck a tree near the river channel and capsized. All the others were rescued. Mr. Grafstrom was born in Sweden and was educated at Stockholm University. He came to the United States in 1883 and soon went to work for the Pennsylvania at Altoona. In 1886 he was transferred to Columbus, Ohio, and in 1892 he was appointed Mechanical Engineer there. In 1900 he resigned to go to the Illinois Central in a similar capacity, but shortly left this latter position to go to the Atchison. Here also he was Mechanical Engineer, and he held that position at the time of his death. Mr. Grafstrom had quite recently received a proposition to go to Australia as a railroad mechanical superintendent.

ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—W. W. White has been appointed Auditor of Disbursements, with office at Topeka, Kan., succeeding I. S. Lauck.

Atlantic Coast Line.—J. N. Brand, heretofore Assistant Superintendent of Transportation, has been appointed Superintendent of Transportation.

Atlanta, Knoxville & Northern.—W. F. Teat has been appointed Master Mechanic, with headquarters at Blue Ridge, Ga., succeeding S. J. Anderson, deceased.

Birmingham & Atlantic.—W. Henry Lane has been appointed Superintendent, with headquarters at Talladega, Ala., succeeding W. L. Law.

Cadiz.—F. G. Terry has been elected Treasurer, with office at Cadiz, Ky., succeeding E. R. Street, resigned.

Chicago & North Western.—William Hutchinson has been appointed Master Mechanic of the Iowa and Minnesota Division, with headquarters at Mason City, Ia., succeeding E. B. Thompson, who succeeds Mr. Hutchinson at Winona.

Cleveland, Cincinnati, Chicago & St. Louis.—E. D. Higgins has been appointed Assistant Auditor, with office at Cincinnati, Ohio.

Cumberland Valley.—H. C. Clevenger has been appointed General Freight Agent, with headquarters at Harrisburg, Pa., succeeding A. L. Langdon, resigned.

Denver & Rio Grande.—J. F. Lodell has been appointed Superintendent of Dining Car Service, with office at Denver.

Erie.—George J. Schoeffel has been appointed Superintendent of Police, with office at Jersey City, N. J., succeeding George W. Douglass, resigned.

Louisiana & Northwest.—D. M. Higgins has been appointed General Freight and Passenger Agent, with headquarters at Gibsland, La.

Mexican Central.—A. C. Hobart has been appointed Superintendent of the San Luis Division, with headquarters at Cardenas, Mex., succeeding C. O. Wheeler, resigned.

Mobile, Jackson & Kansas City.—A. E. Davis has been appointed Second Vice-President and Purchasing Agent.

Morgantown & Kingwood.—P. Hayden has been appointed Master Mechanic, with headquarters at Morgantown, W. Va., succeeding G. E. McGee.

New York, New Haven & Hartford.—A. W. Martin has been appointed Assistant General Superintendent, with headquarters at Boston, Mass. A. F. Currier, heretofore Car Accountant, has been appointed Superintendent of Car Service. J. W. Pearson and J. W. Browne have been appointed Division Engineers, with headquarters in Boston.

E. H. Morse has been appointed Assistant Superintendent of the Providence and Midland Divisions, with headquarters at Boston, Mass.

Plant Line (Steamship).—At a meeting held June 13, A. S. Hayes was elected President; A. W. Perry, of Boston, Treasurer, and H. L. Chipman, of Halifax, N. S., Secretary.

Paragould Southeastern.—F. H. Britton has been elected President, succeeding W. C. Hasty, resigned. J. M. Lowe has been appointed First Vice-President (succeeding Mr. Britton), also General Freight and Passenger Agent and Auditor. H. E. Farrell has been appointed Traffic Manager.

Toledo & Western (Electric).—Frank La Seur has been appointed Cashier, succeeding F. S. Brigham, resigned. Ira Southwick, heretofore General Foreman, has been appointed Master Mechanic. The position of Purchasing Agent has been merged with that of General Manager.

Union Pacific.—Arthur H. Fetters has been appointed Assistant Mechanical Engineer, with headquarters at Omaha Shop.

Virginia & Southwestern.—John B. Newton has been appointed Vice-President and General Manager, with headquarters at Radford, Va.

LOCOMOTIVE BUILDING.

The Georgia Southern & Florida is having one locomotive built at the Schenectady Works of the American Locomotive Co.

The Seaboard Air Line, as reported in our issue of June 12, has ordered nine simple 10-wheel (4-6-0) locomotives from the Baldwin Works. These locomotives will weigh 152,500 lbs., with 120,000 lbs. on drivers; cylinders 20 in. x 28 in.; wagon-top radial boiler, with working steam pressure of 200 lbs.; heating surface, 2,644 sq. ft.; 332 iron tubes 2 in. in diameter and 14 ft. 1⅞ in. long; carbon steel fire-box, 9 ft. long and 3 ft. 5 in. wide; tank capacity, 5,000 gal.; coal capacity, 12 tons. Special equipment includes Westinghouse-American air brakes, magnesia sectional boiler lagging, solid brake beams, Tower couplers, Pyle-National headlights, Monitor No. 10 injectors, Ajax journal bearings, U. S. metallic piston rod and valve rod packings, Coale's safety valves, Leach sanding devices, Nathan sight-feed lubricators and Ashcroft steam gages.

The Louisville, Henderson & St. Louis, as reported in our issue of June 5, has ordered two simple 10-wheel (4-6-0) locomotives from the American Locomotive Co. for September, 1903, delivery. These locomotives will weigh 111,500 lbs., with 86,000 lbs. on drivers; cylinders, 18 in. x 26 in.; straight boiler with a working steam pressure of 160 lbs.; heating surface, 1,415 sq. in.; 218 tubes 2 in. in diameter and 12 ft. 5 in. long; fire-box 96 in. long and 34½ in. wide; tank capacity, 3,500 gal.; coal capacity, 7 tons. Special equipment includes Westinghouse air brakes, American Locomotive Co.'s axles, headlights, journal bearings, steam gages, and driving wheel tires, magnesia sectional boiler lagging, Washburn couplers, Sellers injectors, U. S. piston rod packings, Richardson balanced valves, Leach sanding devices, Pittsburg Steel & Spring Co.'s springs.

CAR BUILDING.

The American Car & Foundry Co. has miscellaneous orders for 92 cars.

The Alabama Great Southern is reported in the market for 100 coke cars.

The International & Great Northern is reportd in the market for 100 stock cars.

The Oregon R. R. & Navigation Co. has ordered two dining cars from the Pullman Co.

The Pennsylvania is having 80 freights built by the Western Steel Car & Foundry Co.

The Lake Shore & Michigan Southern is having 900 freights built by Haskell & Barker.

The St. Louis Southwestern has ordered 2,000 box cars from the American Car & Foundry Co.

The Kanawha Coal & Coke Co. has ordered 11 hopper cars from the American Car & Foundry Co.

The Mexican International is having 50 freight built at the Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill.

The Lackawanna & Wyoming Valley is having 10 freights built at the Berwick Works of the American Car & Foundry Co.

The Chicago Great Western is reported to have ordered 100 stock cars, 100 furniture cars and 500 box cars from the Pullman Co.

The St. Louis & San Francisco has ordered 27 coaches, six chair cars, six postal cars and one cafe car from the American Car & Foundry Co.

The Atchison, Topeka & Santa Fe, as reported in our issue of May 29, has ordered 300 furniture cars of 60,000 lbs. capacity from the American Car & Foundry Co. These cars will be 40 ft. long, 9 ft. wide and 10 ft. high, inside measurements, with frames and underframes of wood. Special equipment includes Westinghouse brakes, Miner draft rigging, cast steel bolsters, Security doors and cast steel trucks.

The Gulf & Ship Island is building 60 box cars of 80,000 lbs. capacity at its Gulfport shops. The cars will be 40 ft. long, 8 ft. 4 in. wide and 8 ft. 2 in. high. The special equipment includes: American steel bolsters, Damascus brake beams, Lappin brake shoes, Westinghouse air-brakes, Tower couplers, Thornburgh draft rigging, Waycott dust guards, National journal boxes and lids, Railway Steel Spring Co.'s springs, diamond trucks and Dickson wheels.

The Denver, Northwestern & Pacific, as reported in our issue of June 5, has ordered 50 flat cars from Barney & Smith for July, 1903, delivery. The cars will weigh approximately 23,000 lbs., and will have a capacity of 60,000 lbs. They will be 36 ft. long and 8 ft. 6 in. wide. Special equipment includes Carnegie steel axles, Barney & Smith metal bolsters and Diamond patented trucks, Westinghouse brakes, Tower couplers, Miner draft rigging, Harrison dust guards, McCord malleable journal boxes and journal box lids, Sherwin-Williams paint.

The Southern, as reported in our issue of May 22, has ordered 20 baggage and express and eight postal cars from the American Car & Foundry Co. These cars will be 61 ft. long and 9 ft. 8½ in. wide over sills. Special equipment includes Midvale tires, four-wheel trucks on the baggage and express cars, and six-wheel trucks on the postal cars; National hollow brake-beams on the postal cars, and Diamond special brake-beams on the baggage and express cars; Corning shoes, Janney-Buhoup couplers, McCord journal boxes, Harrison dust guards, Pintsch gas, Baker heaters, Standard steel platforms, Gold steam heating system in the baggage and express cars and Buhoup vestibules.

F. M. Hicks of the Hicks Locomotive & Car Works has received orders for rebuilding the following passenger equipment: Two combination cars and two passenger coaches for the Chicago Short Line; one passenger coach and one combination car for the Manistee & Northeastern; one baggage car for the Duluth, Missabe & Northern; two chair cars for the Waterloo & Cedar Falls Rapid Transit; two passenger coaches for the Lehigh & Hudson River; one passenger coach and one combination car for the Tremont & Gulf; one passenger coach for the Transylvania. Also freight equipment for the following roads: 10 flat cars for the Weed Lumber Co. of California; 50 gondolas for the Trinity & Brazos Valley; one caboose for the Tremont Lumber Co.; 10 flat cars for the Coos Bay, Roseburg & Eastern, and miscellaneous cars for the New River, Holston & Western, Coal Belt Ry., and the American Steel & Wire Co.

BRIDGE BUILDING.

ALEXANDRIA, S. DAK.—The County Auditor will receive bids July 6 for three small steel bridges to be built by Hanson County.

ALLENTOWN, PA.—A commisssion appointed by the Dauphin County Court has inspected a site for a bridge over Lehigh River.

ALVISO, CAL.—The County Surveyor is preparing plans for two stone bridges to be built near this place. Henry A. Pfeister, County Clerk.

ANGELICA, PA.—The Berks County Court has authorized a new bridge over Angelica Creek.

ASHLEY, PA.—Bids are wanted June 22 for a concrete bridge to be built by the borough over Solomon's Creek.

BENTONSPORT, IOWA.—Van Buren County will soon build a 200-ft. iron bridge over Des Moines River. The Board of Supervisors is considering building another bridge over the Des Moines River in the near future.

CATASAUQUA, PA.—The court has appointed viewers for a county bridge over Lehigh River.

CHEBOYGAN, MICH.—The Detroit & Mackinac R. R. Co. has petitioned the Board of Supervisors for permission to build a steel bridge over Cheboygan River.

CHIPMAN, N. B.—The Central Ry. bridge, about one and one-half miles from this place, was recently destroyed by fire.

CLAREMONT, N. H.—It is stated that the Selectmen are ready to let the contract for a bridge over Connecticut River to cost about $40,000.

DEADWOOD, S. DAK.—E. H. Warren, Auditor of Lawrence County, will receive bids until noon, July 7, for three steel bridges.

DEERFIELD, MICH.—N. Manly, Township Clerk, will receive bids until noon, July 3, for a 270-ft. steel bridge to be built over Raisin River.

DES MOINES, IOWA.—The Rock Island R. R. is said to have plans made for a new girder bridge over Des Moines River.

EAST HARTFORD, CONN.—The town has petitioned the State Railroad Commissioners to abolish the grade crossing at Main street, and a steel overhead bridge may be built.

FOND DU LAC, WIS.—It is said that the Town Board has voted to build an iron or steel bridge over Fond du Lac River to replace a wooden structure near Mihill's Corners.

FREDERICTON, N. B.—The Commissioner of Public Works will receive bids Aug. 10 for the steel superstructure of the Bucknehe bridge, Kent County, to consist of one through fixed truss span, 95 ft. 3 in. long, and one through swing draw span, 280 ft. 6 in. long. Bids for the substructure are due on June 29.

The Commissioner of Public Works will receive bids until July 13 for the steel superstructure of Ward's Creek bridge at Sussex, and the Charlo River bridge in parish of Colborne, Restigouche County.

HARTFORD, CONN.—Bids for the stone bridge over Connecticut River will be received by the Board of Commissioners at Room 52, Aetna Life Bldg., 650 Main street, until noon, July 1. The bridge is to be about 1,185 ft. long and 80 ft. wide, and includes eight stone arches and a 100-ft. draw span, with foundations, piers and abutments. The steel superstructure of the draw is not to be included in the bids. Morgan G. Buckley, President, Connecticut River Bridge & Highway District; Edwin Dwight Graves, Chief Engineer.

HARTFORD, WIS.—The Council has voted to build two stone bridges over the river at Rural street.

JEFFERSONTOWN, KY.—An overhead bridge may be built at this place to carry the street railroad lines over the tracks of the Southern Ry.

LANCASTER, WIS.—It is stated that Grant County will build a steel bridge over Platte River.

LODI, N. J.—The Board of Freeholders will receive bids until June 20 for a bridge over Saddle River.

LOGANSPORT, IND.—It is said that the Frankfort-Logansport Traction Co. will build a bridge over Wabash River.

LOWELL, MASS.—Estimates have been made for steel bridges at Pawtucket and New York streets.

MINNEAPOLIS, MINN.—A section of the union station viaduct recently collapsed.

MODESTO, CAL.—The County Surveyor is said to be preparing plans for a new bridge over Little John Creek.

MONTGOMERY, ALA.—It is reported that a $75,000 highway bridge may be built at this place.

MONTREAL, QUE.—The City Clerk will receive bids until June 25 for rebuilding the St. Catharine street bridge, recently partially destroyed by fire.

Natrona, Pa.—Viewers have recommended a bridge over Allegheny River.

Newark, N. J.—Bids will be opened at 196 Market street, June 30, for the new draw to be built by the Freeholders of Essex and Hudson counties over Passaic River at Bridge street.

New York, N. Y.—The New York Connecting R. R. Co. has applied to the Rapid Transit Commission for a franchise for a bridge from Mott Haven to Astoria, over Ward's and Randall's islands, with a viaduct from Astoria to the Long Island terminal, Long Island City.

Oconomowoc, Wis.—The city and the La Belle Cemetery Association have been authorized by the Legislature to build a bridge over Oconomowoc River from Ann street to the cemetery grounds.

Orange, Va.—Black bridge, a mile and a half east of this place on the Fredericksburg road, has been carried away by high water.

Pikeville, Ky.—Bids are wanted June 30 for four small steel and stone arch bridges to be built by the county.

Portland, Ore.—The Oregon Water Power & Railway Co. will build a steel double track bridge over Clackamas River.

Reading, Pa.—A new county bridge will be built over Maiden Creek in Greenwich Township.

St. John, N. B.—It is reported that several highway bridges near this city and four bridges on the New Brunswick Southern R. R. have been destroyed by fire.

St. Paul, Minn.—Plans are being made for a new bridge on the Mendota road, about a mile from the end of the Mississippi & West St. Paul street car line.

The Board of Aldermen has voted to replace with steel the wooden portions of the East Sixth street bridge.

Schenectady, N. Y.—The Ferry bridge over Mohawk River may be rebuilt.

Vancouver, B. C.—The Dominion Government department of railroads has approved the plan of the bridge to be built by the Great Northern across False Creek, on the extension between Westminster and Vancouver, B. C. The bridge will be about 4,000 ft. long and will have a span 120 ft. long in the middle.

Wapelo, Iowa.—The wagon bridge over Iowa River has been carried away by high water.

Washington, D. C.—Bids will be received at the U. S. Engineer Office, 2001 I street, N. W., until noon June 25, for a highway bridge to be built over Potomac River. Chas. J. Allen, Lt. Col. Engrs.

Washington, Ind.—It is reported that surveys are being made for a new railroad bridge over White River.

Waukegan, Ill.—It is reported that the Supervisors of Lake County will build an iron bridge over Desplaines River in Newport Township.

West Seneca, N. Y.—The Town Board has decided to build a wagon bridge over the south branch of Smoke Creek in Electric avenue.

Other Structures.

Aliquippa, Pa.—The Vulcan Crucible Steel Co. has bought four acres of ground adjoining its present plant to use for an extension to the smelting department. The new open hearth furnace is about completed.

Dayton, Ohio.—The plant of the Ohio Foundry Co. is reported to have been badly damaged by fire.

New Orleans, La.—The New Orleans Railway Co. is planning to build extensive car shops on Canal street. The Poland street car barn will also be rebuilt, and the capacity of the Arabella barn will be doubled.

New York, N. Y.—McDougall Hawkes, commissioner of docks and ferries, has advertised to receive bids until noon, June 24, for a new pier near the foot of Peck Slip, East River, to be known as Pier No. 19, or Peck Slip Pier West. The cost will be about $75,000.

Painesville, Ohio.—The Baltimore & Ohio car shops are reported to have been destroyed by fire.

Pittsburg, Pa.—The Union Forge Co., capital $500,000, has been incorporated to build a plant here.

The Jones & Laughlin Steel Co. may build a fifth blast furnace on a tract of land recently purchased near the Eliza furnaces on Second avenue.

Riverside, Cal.—The San Pedro, Los Angeles & Salt Lake R. R. will soon select depot sites in this city.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Alpena, Gaylord & Western.—Bids are now being asked for grading this line from Alpena, on Lake Huron, to Gaylord, Mich., 63 miles. Surveys have been finished and rights of way secured. The proposed route will run through Alpena, Mancelona, Traverse City, Frankfort and Gaylord. C. M. Stevens, 602 Majestic Bldg., Detroit, Mich., is Chief Engineer; W. M. Durand, President. (May 22, p. 368.)

Atchison, Topeka & Santa Fe.—The line which this company is building from Richmond, Cal., to Oakland, 10 miles, will be finished about Jan. 1, 1904. Eighty-five pound rails will be used and ballast will be broken stone throughout. All waterways will be crossed by concrete arched culverts, and an overhead steel girder span 100 ft. long will be used to cross over the tracks of the Southern Pacific near Richmond. (Official).

Baltimore & Ohio.—Work is reported in progress on a large viaduct at Bellaire, Ohio, which will connect the main line of the Baltimore & Ohio with the Cleveland, Lorain & Wheeling. This viaduct will cost about $500,000. Another large piece of work will be the building of a second track between Bridgeport and Lorain.

It is reported that arrangements have been practically finished for making the main line of this company a four-track road from Wheeling to McKeesport, Pa. Work will begin just beyond the Glenwood yards (Wheeling Junction) and will continue along the north bank of the Monongahela River to Braddock. From the east side of Braddock to Turtle Creek there will be another four-track stretch, and from Turtle Creek to the Demmier yards there will be six tracks. The four-track line will then be continued to McKeesport.

Contracts have been awarded for grading a branch of this road from Burnersville, W. Va., to Buckhannon, 12 miles. The work is heavy, with several large cuts and a number of small tunnels.

Bay of Quinte.—Surveys are reported finished for this proposed line from Tweed, Ont., via Actinolite and Queensboro, to Bannockburn, 25 miles. Connection will be made with the Central Ontario at Bannockburn. P. E. McCoy, Deseronto, Ont., is reported to have contracted for building this line. (May 15, p. 351.)

Bellingham Bay & British Columbia.—Surveys are reported finished for the extension of this line from Bridgeport, Ore., to a point in Whatcom County. The proposed route will be from Bridgeport down the Columbia River to the Okanogan River; thence across the river to the Methow river and into the slate district, Whatcom County, Wash., to a terminus at the junction of the Canyon and Grand creeks, 85 miles. (April 3, p. 254.)

Birmingham, Columbus & St. Andrew's Bay.—Contract is reported let to the Southeastern Railroad Construction Co. of New York for building this line from Birmingham, Ala., via Columbus, Ga., to St. Andrew's Bay, Fla., 360 miles. Grading is reported in progress at Chipley, Fla. W. O. Butler, Columbus, Ga., is said to be interested. (May 27, p. 367.)

Brooklyn Rapid Transit.—It has been announced by General Manager Calderwood that the legal obstacles against the building of four new loops at the Manhattan terminal of the bridge have been removed, and that work will be begun very shortly. It is estimated that the new improvements will cost about $90,000. The proposed loops will be built inside the present tracks and, in order that they may be of the required size, the roadway on either side of the bridge will have to be widened. It is estimated that most of this work can be done at night and will not interfere in any way with the present traffic arrangements.

Buffalo, Dunkirk & Western.—Work is reported in progress on this line between Fredonia, N. Y., and Westfield. The new line will connect with the Lake Erie Traction at Westfield, and will parallel the Lake Shore & Michigan Southern between Angola and Buffalo. Contract for the section between the two latter points has been let to Foley Bros., of Columbus, Ohio.

Canadian Pacific.—Traffic on the line at Frank, Alberta, has been suspended owing to the landslide at Turtle Mountain on April 29, 1903. The old line has been abandoned and a new line east of the old one is now being built under the direction of E. H. McHenry, Chief Engineer. (May 15, p. 351.)

Chattanooga Southern.—Press reports state that this road will soon begin work on a four-mile extension from a point near Chesterfield, Cherokee County, Ala., west to the base of Lookout Mountain, where connection will be made with the mines of the Lookout Mountain Fuel Co.

Chicago, Milwaukee & St. Paul.—A new branch of the Superior Division of this road has been opened for business, extending from Wausaukee, Wis., westward to Girard Junction, 18 miles.

Colorado, Oklahoma & Texas.—An officer writes that this company has recently adopted an amendment to its charter and will build a line from Denison, Texas, through the Chickasaw Nation, Ind. T., and Ardmore, Duncan, Lawton, Hobart and Elk City in Oklahoma Territory; thence northwest through the panhandle of Texas, passing through the towns of Canadian, Ochiltree and Hansford to Pueblo, Colo. The new line will cross the Gulf, Colorado & Santa Fe at Ardmore; the Chicago, Rock Island & Pacific at Duncan; the St. Louis & San Francisco at Lawton; the Kansas City, Mexico & Orient about 12 miles northwest of Hobart in Washita County; the Choctaw, Oklahoma & Gulf at Elk City; the Atchison, Topeka & Santa Fe at Canadian, and the Chicago, Rock Island & Texas at Tehoma. It is expected to materially shorten the distance between Colorado and southeastern Gulf points about 100 miles. Location surveys have been made from Hobart north through Kiowa, Washita and Roger Mills counties. Two more locating parties will be put in the field at once, one working from Duncan southeast to Denison, and one from Duncan northwest to Hobart. It is the intention to have the line located from Denison to Canadian by Sept. 1. Contracts for the south end will be let within 90 days. The maximum grades are 1 per cent., and the maximum curves 4 deg. There will be no tunnels and very few bridges. E. E. Colby, Hobart, Okla. T., is Chief Engineer.

Curwensville & Bower.—The contract was recently let to McArthur Bros., Chicago, for grading this line from a point near Curwensville to Bower, in Clearfield County, Pa., 16 miles. (June 5, p. 400.)

De Kalb & Southwestern Electric.—An officer writes that this company, which was recently incorporated in Illinois, has let a contract to Charles T. Gregory, New York, for grading the 15 miles of road between De Kalb and Stewart. The work is easy, with no important bridges or tunnels. G. H. T. Shaw is President, and A. M. Shaw, Chief Engineer, Dixon, Ill. (June 12, p. 416.)

Denver, Northwestern & Pacific.—Bids will be received by this company up to June 30 for building the Main Range tunnel. This tunnel is to be 2½ miles long, through the Continental Divide, 50 miles west of Denver, and the work includes the completion of all approaches, cuts and embankments. A. C. Ridgway, Denver, Colo., is General Manager, and H. A. Sumner, Chief Engineer.

Detroit Southern.—An officer writes that an extension of this line from Lawrence Furnace, Ohio, to Bloom Switch, 19½ miles, has been finished. This extension together with the Iron Ry. will in future be known as the Southern Division of the Detroit Southern, extending from Lima, Ohio, to Ironton. (May 15, p. 352.)

El Paso & Southwestern.—The new branch of this road from Fairbanks, Ariz., eastward to Tombstone, nine miles, has been finished. (See Construction Supplement.)

Escanaba & Lake Superior.—Grading is reported in progress on an extension of this line from Gleason, Mich., in a northeasterly direction into timber lands, 13 miles. Location surveys have been finished and it is reported that the line will soon be ready for track laying.

Fenton & Thomson.—Articles of incorporation have been filed by this company to build a line from a point on the Chicago, Burlington & Quincy, two miles north of Fenton, Whiteside County, Ill., to a point about three miles south of Thomson, a total distance of 12 miles. This is reported to be a Burlington project, as it connects two branches of the C., B. & Q. H. W. Weiss, Hinsdale, Ill.; J. M. Deering, La Grange, Ill.; C. V. Carpenter, Downers Grove, Ill., and others are incorporators.

Flat Top.—An officer writes that this company, which was recently incorporated in West Virginia, will build from Raleigh up Beaver Creek to Bramwell, 35 miles. Contracts for grading will be let in about 30 days. The character of the work will be light, with no bridges or tunnels. C. E. Hawker, Fairmount, W. Va., is President, and Geo. W. Milnes, Clarksburg, is Chief Engineer. (June 5, p. 400.)

Fort Smith, Blackwell, Wellington & Northwestern.—A charter has been granted this company in Oklahoma. The proposed route is from Fort Smith, Ark., northwest through the Cherokee and Creek Nations to Cleveland, Okla. T., 130 miles; thence through the Osage and Ponca reservations to Blackwell, 70 miles. From [illegible] one line is to run northwest to Wellington, Kan., and another south to Perry, Okla. T. The incorporators are all citizens of Blackwell and Wellington.

Georgia, Florida & Alabama.—At a recent meeting of the directors of this company, it was voted to extend the line from Tallahassee, Fla., east to Jacksonville, about 100 miles. Surveying parties will be put in the field at once. An extension is also projected from Cuthbert, Ga., north to Columbus, 50 miles.

Helena, Tupelo & Decatur.—Rights of way are now being secured by this company for a line through Morgan, Lawrence and Marion counties, Alabama, to a point on the Mississippi State line. Surveys for the road have been finished, and it is reported that contract for grading will be let within the next six months. W. D. Anderson, Tupelo, Miss., is President.

Huron, Erie & Buffalo.—Incorporation has been granted this company by the Ontario Legislature to build a line from St. Thomas, Ont., east to Niagara River, 100 miles, and west to Sarnia, 60 miles. The Pere Marquette is reported to be behind this new project.

Interborough Rapid Transit.—Plans are now being considered by this company for relieving the traffic congestion at Broadway, Sixth avenue and Thirty-fourth street, New York city. It is proposed to run the Broadway cars through a subway from Thirty-second street to Thirty-fifth. This would still leave the Sixth avenue and Thirty-fourth street lines crossing each other. The plan contemplates a transfer station at Thirty-fourth street.

Intercolonial.—Press reports state that a second track will be built between Richmond and Rockingham, N. S., 2½ miles. Bids are reported as being asked. The new track will be laid with 80-lb. rails and the contract calls for its completion by Aug. 31, 1903. It is also stated that a second track will be built from Richmond to Windsor Junction, 13 miles.

Interoceanic of Mexico.—It is stated that, as a result of the recent purchase of a part interest in the National R. R. of Mexico by the Mexican Government, the Interoceanic is to be converted from a narrow gage to a standard gage road. The Mexican Government also owns an interest in the Interoceanic, and proposes to operate it in connection with the National. The latter has just been made standard gage.

Kansas City, Mexico & Orient.—A concession has been granted this company by the Mexican Government for building a line either from Minaca, the present terminus of the Chihuahua & Pacific, or from Bocoyna, to Jesus Maria, all in the State of Chihuahua. It is reported that surveys for the new line will be begun within a few weeks, and the concession calls for the completion of at least 15 miles of road before Jan. 1, 1905.

Kansas, Oklahoma & Gulf.—It is reported that this company will shortly be organized to build a line from Coffeyville, Kan., through the Cherokee and Osage Nations, and the Counties of Pawnee, Logan, Blaine, Prescott, Washita, Kiowa and Greer, to a point in Collingsworth County, Texas, where connection will be made with the Fort Worth & Denver City. The total length of the line will be about 450 miles. T. L. Eggleston, Nashville, Tenn., is reported to be interested.

Lake Keuka & East Side Electric.—Surveys are reported finished for this new electric line, and rights of way secured. Bids will be asked for grading the line from Penn Yan to Keuka, 34 miles, about July 1. M. F. Sheppard, Penn Yan, N. Y., is President. (May 8, p. 336.)

Little Rock & Monroe.—This company has been incorporated in Arkansas to build from Lapile, Ark., south to Monroe, La., 50 miles. E. A. Frost, Texarkana, Ark.; J. E. Rutherford, Pine Bluff, and J. E. Cavanaugh, Lapile, Ark., are directors.

Los Angeles Interurban.—This company has recently been incorporated in California to build a series of electric lines out of Los Angeles into southern California. The company is capitalized at $10,000,000. H. E. Huntington, Los Angeles, Cal., is said to be interested.

Masontown & New Salem.—An extension is to be built by this company from New Salem, Pa., to Brownsville, on the Monongahela Division of the Pennsylvania, a distance of about 12 miles. This line is controlled by the United States Steel Corporation, and connects the plants of the steel company with the Pennsylvania and Baltimore & Ohio railroads.

Mena & Black Springs.—Surveys are reported in progress on this line from Mena, Ark., to Black Springs, 35 miles. Contracts for grading will probably be let about Aug. 1. J. F. Todd, Mena, is Secretary. (See Construction Supplement.)

Michigan Central.—This company has filed maps showing the connecting line between its Toledo, Canada Southern & Detroit, and Detroit, Delray & Dearborn divisions, with crossings of the Lake Shore & Michigan Southern and Wabash in Wayne County.

Midland Valley.—A charter has been granted this company in Arkansas. The proposed route of the new line is from Fort Smith in a southeasterly direction through Greenwood to Hartford, 53 miles. Branch lines will be built from Hartford in an easterly direction, and from Montreal in a southeasterly and northwesterly direction. The road will parallel the Arkansas Central between Fort Smith and Greenwood. Surveys are reported finished, and it is said that the contract for grading will shortly be let. J. W. McLoud, Little Rock, Ark.; F. A. Molitor, C. M. McCullough and others, of Fort Smith, are incorporators.

Nacozari R. R.—An officer writes that work is now in progress from Cos, in the State of Sonora, Mexico, south to Nacozari, 20 miles. Orman & Crook, Douglas, Ariz., have the contract for grading. The material has already been purchased and no new rolling stock will be needed. J. T. Logan, Douglas, Ariz., is the superintendent in charge of the work. The accompanying map shows the proposed extension. (June 12, p. 416.)

New Jersey, Indiana & Illinois.—This company is reported to be making preparations to build a line from

the division of the Wabash to South Bend, Ind. The proposed route is from a point half way between Lakeville and North Liberty, in a northeasterly direction. Connection will be made with the Lake Shore & Michigan Southern, a short distance west of South Bend. The line will be about 11 miles long.

New Orleans & Gulf Ry. & Navigation.—This company, which has recently been chartered in Louisiana, proposes to buy about 500,000 acres of land between the Mississippi River and Bayou La Fourche and to develop it by building canals and railroads. W. W. Goodwin, Memphis, Tenn.; C. A. Ramsey, New Orleans; L. B. Bothwell, Carthage, Mo., and others are incorporators. The capital stock is reported to be $10,000,000.

Northern Pacific.—The new branch of this road, extending from Kalama, Wash., down the north bank of the Columbia River to Vancouver, Wash., 28 miles, has been opened for business. This new line will parallel the Washington & Oregon for a part of the distance, as the latter road also runs along the Columbia River. (See Construction Supplement.)

Oklahoma & Rio Grande Southern.—It is reported that this company will shortly be organized to build a line from Oklahoma City south through Texas to the Rio Grande border. A map has been filed showing the proposed route through Fort Worth and San Antonio to a point on the Mexican line. L. W. Van Horn, Guthrie, Okla. T., is Chief Engineer.

Oklahoma Traction.—A contract has been awarded to the Metropolitan Construction Co. of Oklahoma City for building this electric line from Oklahoma City to Guthrie, 35 miles. Grading will be begun at once.

Oregon Railroad & Navigation.—Contract has been let to the Pacific Coast Construction Co., of Portland, Ore., for filling in 30 trestles on the Oregon R. R. & Navigation Company's line between Walla Walla and Spokane, and between Umatilla and Huntington. Work will be begun at once.

Orford Mountain.—Grading is reported in progress on an extension of this line from Kingsbury, Que., to Windsor Mills, 7½ miles. The road is at present in operation between Eastman and Kingsbury, 27 miles. (See Construction Supplement.)

Ottawa Valley.—At a recent meeting of the stockholders of this company it was voted to extend the present line from St. Andrew's to Carillon, and also to purchase the Carillon & Greenville R. R. Edgar McMullen, of Boston, is President, and H. W. Raphael, Montreal, Vice-President.

Pennsylvania & Mahoning Valley (Electric).—An officer writes that work has been begun on this road from Youngstown, Ohio, along the south side of the Mahoning River, southeast to Struthers, 2½ miles. The road will be an electric line, with 3 per cent. maximum grades, and will be laid with 90-lb. steel rails. C. K. Hill, Pittsburg, contractor, and J. W. Walker, Youngstown, Ohio, Chief Engineer. (May 1, p. 320.)

Pennsylvania Terminal.—This company has been incorporated in Kentucky to build a terminal line two miles long at Louisville, Ky. This line is projected by the Fall City Belt Line, the rights and franchises of which were recently acquired by the Pennsylvania Company. C. H. Gibson and B. W. Taylor, of Louisville; J. J. Turner, of Pittsburg, and J. J. Brooks, of Sewickley, Pa., are incorporators.

Phillips, Kennan & Chippewa Falls.—Articles of incorporation have been filed by this company in Wisconsin, to build a line from Phillips through Price, Taylor and Chippewa Counties to Chippewa Falls, 75 miles. The company has acquired the franchises and property of the Phillips & La Crosse, running between Phillips and Kennan. J. S. Maxwell, M. A. Hoyt and E. A. Brown, all of Milwaukee, Wis., are incorporators.

Pittsburg, Elk & Southern.—A charter has been granted this company in West Virginia to build from Blacksville south to Clarksburg; thence south to the junction of the Buckhannon and Tygarts Valley rivers, and thence in a southeasterly direction to Belington, Barbour County, W. Va. This is reported to be a Wabash project, as the new road will complete a line from Pittsburg to Belington, connecting with the West Virginia Central at Belington.

St. Louis & San Francisco.—Press reports state that contracts will shortly be let for a cut-off from Evadale, Ark., to Big Creek, 16 miles. If this line is built, it will shorten the distance between Luxora, Ark., and Memphis, Tenn., by several miles. It is reported that J. V. Hanna, Assistant Chief Engineer, Springfield, Mo., will be in charge of the work.

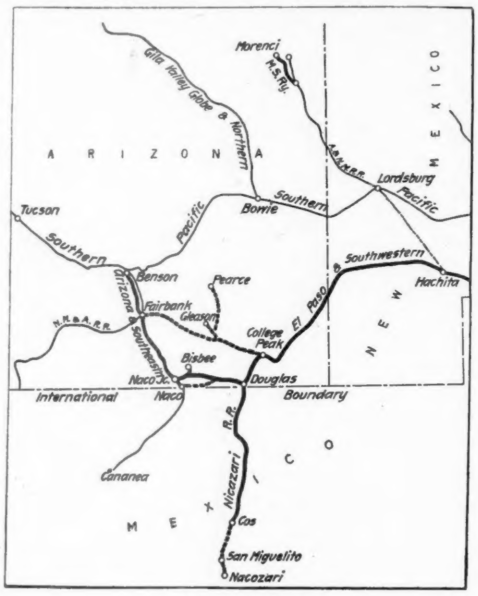
San Pedro, Los Angeles & Salt Lake.—President W. A. Clark has made the announcement that this company will take formal possession of the Oregon Short Line Company's lines south of Salt Lake City on June 30. A contract for the purchase of the southwestern portion of the Oregon Short Line was made several weeks ago, and a meeting will be held in New York City on June 22 for the purpose of ratifying the sale and completing the details. (June 12, p. 416.)

A contract has recently been closed by this company for the purchase of 12,500 tons of steel, and 15,000 tons more will be ordered in a short time. A contract will also be placed in a few days for building the remainder of the road. The contract will call for the laying of more than 300 miles of rails. W. A. Clark, Los Angeles, Cal., is Pesident, and J. Ross Clark, Vice-President. (See Construction Supplement.)

Seaboard Air Line.—An officer writes that the work on the extension of the Seaboard Air Line from Atlanta, Ga., to Birmingham, Ala., is divided into three divisions. The work on the first division will require the removal of about 750,000 cu. yds. of earth. There will be two spans 135 ft. long (Chattahoochee River), with steel viaducts and approaches, and one tunnel 700 ft. long. On the second division there are some 80 odd miles of work, consisting principally in the re-ballasting of the old East & West Railroad. The alinement is being reduced from 14 deg. curves to 4 deg., and the grades from 2 per cent. to a maximum of 1 per cent.; and the original distance will be reduced. The old bridge over the Coosa River will be removed and a new bridge built, consisting of three fixed spans and a draw. The third division, from Coal City to Birmingham, passes across a number of ridges, necessitating two tunnels, one of 900 ft. and one of 800 ft.; and a steel viaduct 123 ft. high. The work is being done under the general specifications of a 1 per cent. grade and a maximum 6 deg. curvature. Passing tracks are being built every five miles. The grade on the first and a portion of the second division must be completed by January, 1904, and the grade on the third division by August, 1903. J. W. Bushnell, Cedartown, Ga., is the engineer in charge of the work.

Southern Indiana Interurban.—According to press reports, this company has made an agreement with the Cleveland, Cincinnati, Chicago & St. Louis so that its cars may pass over the latter's bridge into Louisville. A petition is now before the Circuit Court to change the name of this road to the Lousville & Northern Electric.

Southern Traction.—Articles of incorporation have been filed by this company in Indiana. It is proposed to build an electric railroad from Columbus, Ind., southeast through Hanover to Madison, 45 miles. H. C. Rominger, E. E. Goder and Wm. T. Hubbard, Columbus, Ind., are incorporators.



Nacozari R. R.

Springfield & Southeastern.—This company has been incorporated in Illinois to build from Springfield east to Shelbyville, 50 miles. E. D. Kerr, Brunswick, Ill.; B. P. Smith, Moweaqua, Ill.; T. F. Dover, Shelbyville, and others, are incorporators.

Springfield, Moweaqua, Sullivan & Mattoon.—It is reported that this company is ready to receive bids for grading its proposed line from Springfield to Mattoon, Ill., 75 miles, via Edinburg, Sharpsburg, Moweaqua and Sullivan. Surveys are reported finished. J. B. Titus, Sullivan, Ill., is interested. (May 29, p. 384.)

Tennessee Central.—Work will shortly be begun on the extension of this line from South Harriman, Tenn., to Harriman, two miles. Connection will be made with the Southern at South Harriman. W. H. McDonald is Chief Engineer.

Tennessee Roads.—It is reported that a new railroad will shortly be built from South Pittsburg, Tenn., on the Jasper branch of the Nashville, Chattanooga & St. Louis, in a northeasterly direction to Lancing, Morgan County, on the Cincinnati, New Orleans & Texas Pacific, 90 miles. The proposed line will cross Cumberland County, connecting with the Tennessee Central at a point eight miles west of Crossville. Surveys for the roads are reported in progress between Crossville and Lancing. The new line will pass through a rich coal and oil field and is reported to be a Southern Ry. project. J. H. McCord, West Point, Miss., is one of the promoters.

Zanesville, Marietta & Parkersburg.

Tyronza & St. Francis River.—A charter has been granted this company to build a line from Earl, Crittenton County, Ark., north to Marked Tree, Poinsett County, 21 miles. E. B. Smith, G. W. Patterson, F. E. Carry and John F. Rhodes, of Little Rock, are incorporators.

Union Pacific.—Press reports state that this company will shortly begin work on the Athol cut-off between Cheyenne, Wyo., and Eaton, Colo. The line, when finished, will materially shorten the running time between Cheyenne and Denver. In building the new cut-off, a portion of the abandoned grade of the Colorado Central will be used. The work will involve a number of deep cuts and one long tunnel. It is reported that Kilpatrick Bros., the Wyoming Construction Co., and W. S. Bradbury will be asked to bid on the work. (March 20, p. 220.)

Wabash.—President Joseph Ramsey, Jr., has made the following statement with regard to the plans for new extensions of the Wabash system: Contracts amounting to $10,000,000 will be awarded within the next 30 days for building new extensions and making improvements at Pittsburg. This will also include the building of the Green County road from Pittsburg to Belington, W. Va.; the extension to make a connection with Baltimore; the line from Cumberland to Cherry Run, and the Sawmill Run branch.

Youngstown & Southern (Electric).—Contracts for grading this line have been let to J. W. Fawcett, P. Joyce and V. Heasley, all of Youngstown, Ohio. The proposed route is from Youngstown, via Kyle's Corners and North Lima, to East Liverpool, 44 miles. A. W. Jones, Youngstown, Ohio, is President, and Geo. Todd, Jr., Chief Engineer. (May 22, p. 368.)

Zanesville, Marietta & Parkersburg.—An officer writes that no change has been made in the proposed route of this road from Zanesville via Marietta to Parkersburg. The line is now building from Zanesville southeast to Sharpsburg, Ohio, connecting with the Wheeling & Lake Erie at Zanesville, and with the Marietta, Columbus & Cleveland at Sharpsburg. McArthur Bros., of Chicago, are the contractors. The new line will parallel the Ohio & Little Kanawha for the greater part of the distance between Zanesville and Parkersburg. The maximum grade is 26 ft. per mile, and the maximum curvature 4 deg. There will be three tunnels, two of which will be 1,900 ft. long. The accompanying map shows the proposed route. S. D. Brady, Parkersburg, W. Va., is Chief Engineer. (April 10, p. 274.)

GENERAL RAILROAD NEWS.

Baltimore & Ohio.—The gross earnings of this road for the first 11 months of the present fiscal year were $57,613,773 as against $52,801,315 during the same period in 1902, an increase of $4,812,458. Operating expenses for the same period were $36,125,048 as against $33,799,393 in 1902, an increase of $2,325,655, leaving an increase in net earnings of $2,486,803. Gross earnings for the month of May show an increase of $607,237, or 11 per cent.

Canadian Northern.—The policy of the Dominion Government in regard to the extension of this line is stated as follows by the *Toronto Globe*: "The principal and interest of first mortgage bonds and other securities of the company will be guaranteed to the extent of $13,000 per mile, with interest at the rate of 3 per cent. per annum. Such bonds and other securities are to be secured by a first mortgage upon the line to be built." The sale or the lease of this road to the Canadian Pacific or any other company is forbidden.

Canadian Pacific.—This company has bought the Canadian Pacific Navigation Co. which controls and operates 14 steamers running to Alaska and to Vancouver Island points. The acquisition of these steamers will enable the road to make through rates from eastern ports to Alaskan and British Yukon points.

Chicago & North Western.—The gross earnings of this company for the fiscal year ending May 31, 1903, were $50,041,118 against $46,644,121 in 1902, an increase of $3,396,997. Operating expenses for 1903 were $33,460,828 as against $30,005,642 in 1902, an increase of $3,455,190, leaving a decrease in net earnings for the year of $58,193.

Indiana Union Traction.—This company has been organized with a capital of $5,000,000. It will take over the Union Traction Co. of Indiana under lease. This latter company, which is controlled by Philadelphia capitalists, recently acquired the Indianapolis Northern and has a system of about 200 miles. Randall Morgan and J. Levering Jones, of Philadelphia, are interested in the new company.

Keeseville, Au Sable Chasm & Lake Champlain.—According to report, this road has been sold to a syndicate represented by J. P. Powers, of Lansingburgh, N. Y. The new owners propose to convert the line into a third-rail electric. Options have been obtained for the right of way from Au Sable Chasm to Lake Placid, and it is promised that the line will be running to Lake Placid within a year.

Market Street Elevated Passenger (Philadelphia).—This company has been formed, with a capital of $5,600,000, by the consolidation of the following companies, all of which obtained franchises in 1901: Market Street Elevated, Germantown Avenue Elevated, Passayunk Avenue Elevated, Bridge Avenue Elevated, Frankford Elevated and Broad Street Subway. The company is controlled by the Philadelphia Rapid Transit Co.

Nashville R. R.—This road was sold at foreclosure sale on June 15 to a representative of Ladenburg, Thalman & Co. of New York, in default of payment of interest. Ladenburg, Thalman & Co. represent the majority stockholders.

National R. R. of Mexico.—This company has purchased the Salamanca & Jaral and will operate it in future as its Salamanca-Jaral branch. Connection will be made with the Mexican Central at Salamanca. The total length of the line is approximately 22 miles.

San Jose & Los Gatos Interurban.—A mortgage for $2,000,000 has been filed by this company with the Germania Trust Co. of St. Louis. Bonds will be issued to that amount and the proceeds will be used in building the road.

Seaboard Air Line.—A mortgage for $10,000,000 has been filed by this company to secure an issue of bonds for the purpose of building the extension from Atlanta, Ga., to Birmingham, Ala. The Knickerbocker Trust Co., New York, is trustee. Four per cent. first mortgage gold bonds due May 1, 1933, will be issued. For a description of the new extension of the Seaboard from Atlanta to Birmingham, see Seaboard Air Line (Railroad Construction).

Tennessee Central.—The issue of $1,000,000 in bonds by the city of Nashville, in behalf of the Tennessee Central, has been temporarily enjoined by Judge Clark, of the U. S. District Court. The taxpayers of the city voted to issue the subsidy over two years ago, but the validity of the vote has been questioned. A decision will be handed down shortly.